The Chemical Age

A Weekly Journal Devoted to Industrial and Engineering Chemistry

VOL. LI
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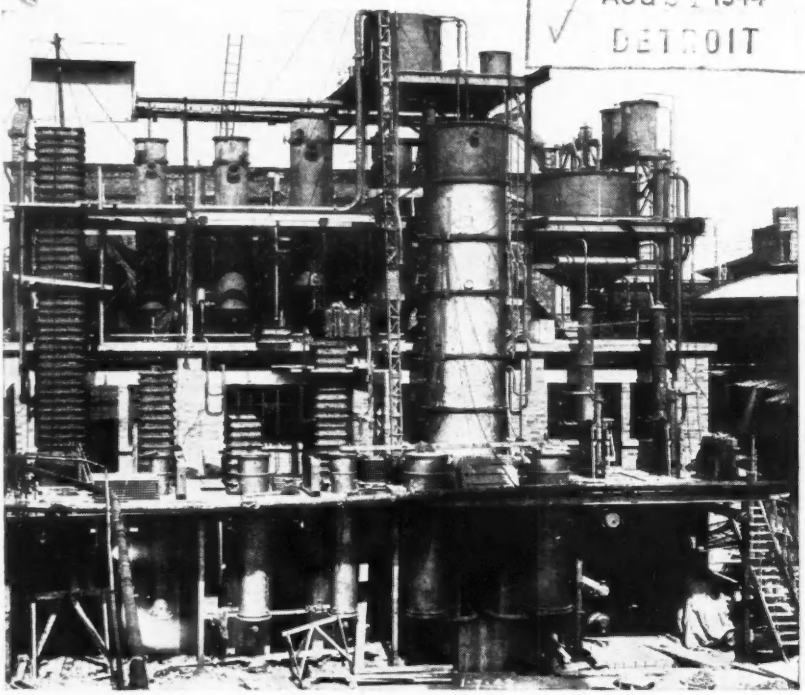

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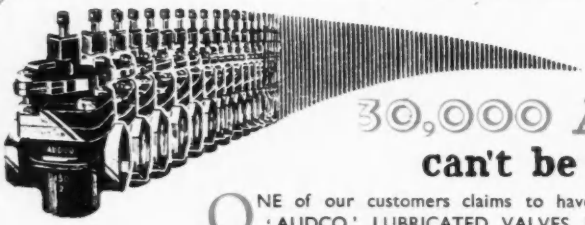

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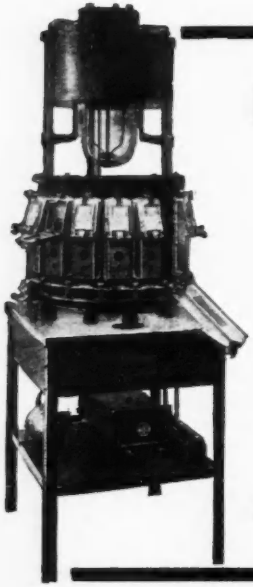

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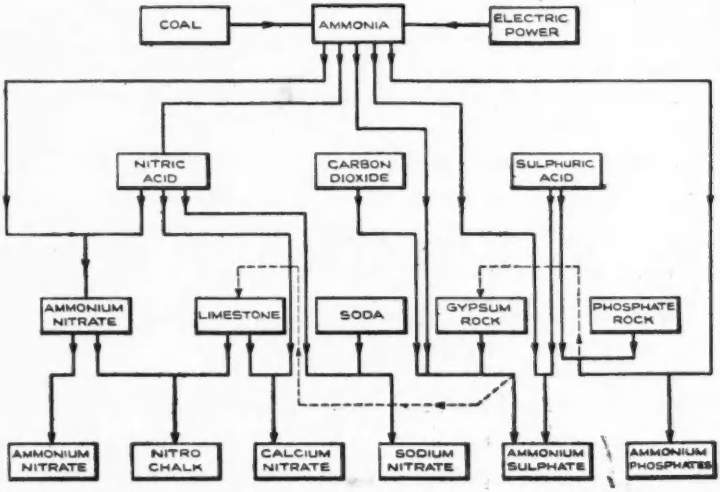

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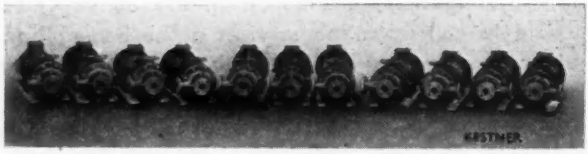

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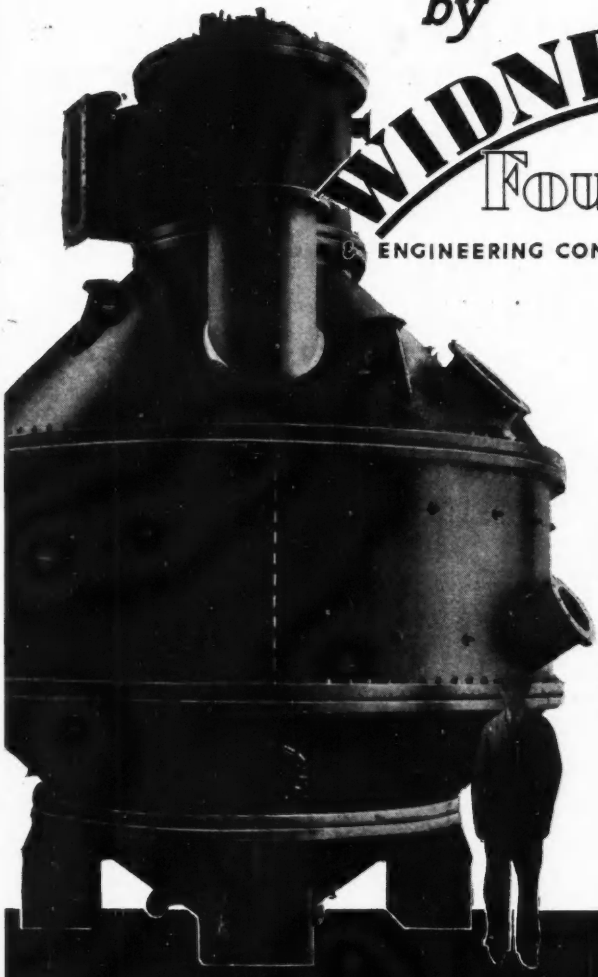

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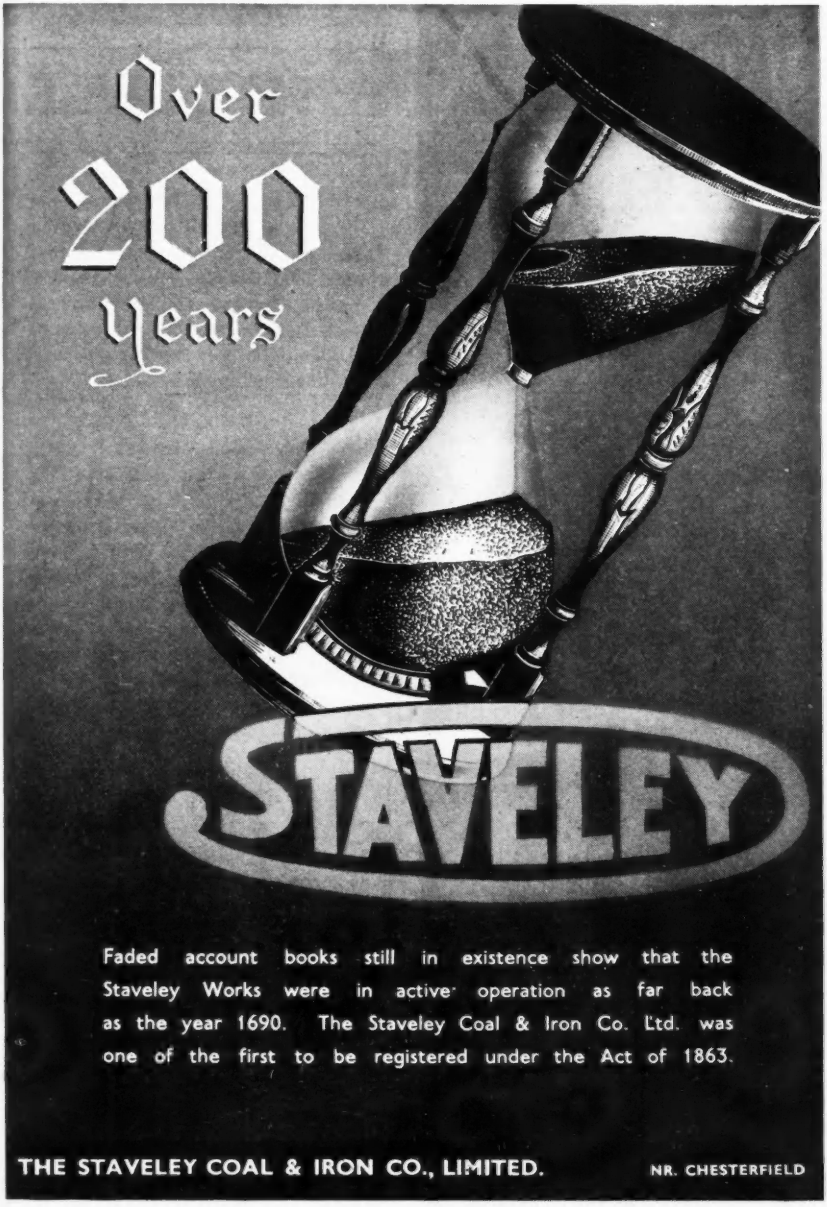

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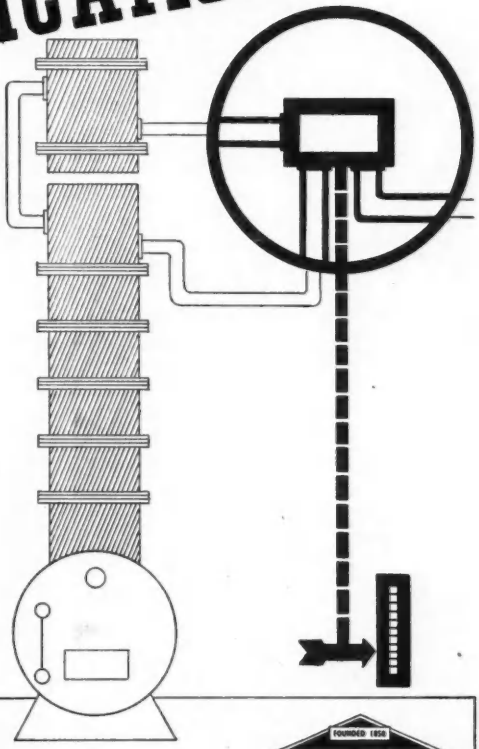

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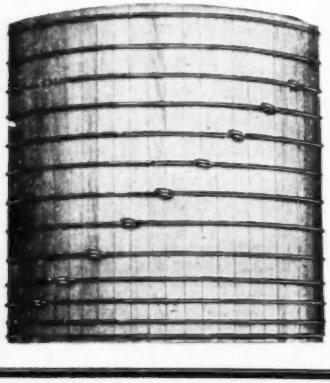

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Mineral Resources

AT a time when everyone seems to be planning vast programmes which will require immense quantities of raw materials, it is well to direct attention to the supply of these essentials. An enormous increase in world trade is projected through an improvement in the standard of living of the more backward nations. This increase is designed, for the time being at all events, to absorb the manufacturing activities of the present industrial nations; and in addition the now backward nations will themselves inevitably become industrialised to some extent, and the demand for the raw materials of the earth will increase at a staggering rate. There are comparatively few raw materials that are completely unlimited in supply so far as present and foreseeable future requirements are concerned. Among these are air, water, the silicates composing clay and other rocks, and to a lesser extent, vegetation.

The British Association appointed a committee to inquire into and report upon the state of knowledge of mineral and metal resources, other than coal and petroleum, essential for modern industrial development from the point of view of the Fourth Clause of the Atlantic Charter—the clause which promised to all States, great and small, victor and vanquished, access on equal terms to the raw materials necessary for economic prosperity. Before it can be implemented there must be knowledge of each nation's mineral resources, together with constant revision in the light of new geological discoveries and industrial development. In solving this problem and other problems of allocation that must arise, the committee was forced to recognise certain general considerations which any international authority charged with the allocation of raw materials must take into account. Countries vary considerably in their mineral resources, and no country is completely self-contained. Although some essential chemical compounds which occur as natural minerals can be made artificially, they can be made only from other mineral resources. For example, cryolite, which occurs only in Greenland, can be made by combining AlF_3 and NaF, but the fluorine must still be obtained from fluorspar, which is not obtainable in all countries.

The rate of exhaustion of minerals presents another series of problems. The consumption of minerals has been increasing so rapidly that the output of most of

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them has doubled within less than 20 years. This rate of consumption will certainly increase with increasing industrialisation and with increasing mass production of goods of every sort. The recovery of scrap metal will retard the date of exhaustion of known mineral deposits, but it is unlikely that it will prevent the acceleration in demand. Modern industry has given great and increasing importance to certain minerals that were relatively unknown a short time ago, and in particular the use of the rare metals has become widespread. Aluminium and magnesium have been advanced from the category of rare metals to the rank of regular materials of industry within a comparatively short time. The steel industry is using large quantities of nickel, chromium, molybdenum, tungsten, vanadium, and cobalt—metals which only occur sporadically and which were regarded as rare or comparatively rare so recently as during the schooldays of many of our readers. Manganese, though not a rare metal, is only found in bulk in a few countries: before the war the Axis countries produced only 2 per cent. of the world's manganese but consumed 16 per cent. of its production, or 26 per cent. of its exportable surplus. More than 80 per cent. of the world's nickel comes from Canada.

Steps must be taken to accelerate production of minerals needed by industry if the Atlantic Charter is to be implemented, but it must also be borne in mind that minerals are a wasting capital asset to the countries that produce them, and to the world in general; we owe it to posterity to use them as economically as possible. For this reason there must be some check upon production and any world mineral bureau that allocates minerals to the several nations should be provided with a sufficiently large and expert technical staff to examine the use made of minerals and their components by each country in order that the rarer metals and salts may be conserved by using substitutes and in other ways. The British steel industry has shown during this war that it can "make do" with alternative metals to a surprising extent when the devil drives. The whole world must do the same even when peace prevails.

The British Association Committee seems to have devoted its attention rather to the machinery for making raw materials available than to their conservation. Thus it states: "As no country can, or will ever be able to, provide from its own natural resources the full variety of minerals which are necessary for its economic prosperity, while some countries possess more than they require of certain minerals, it is necessary to remove, in every way that is practicable, any obstacles which may have hitherto prevented the free interchange of such raw materials."

An international resources bureau might be established after the war to collate existing information about the natural resources of the world, to review technical methods in order to make production more efficient, and to promote research where desirable. Such an organisation, as Dr. Desch has pointed out, "could form the basis of a system of international control, which will be necessary to prevent the squandering of diminishing reserves and to ensure a fair distribution to consuming countries." Many believe that the greatest contribution to the problem of conservation of supplies is the technical approach. This can be exercised in three directions. The first is that of greater recovery of minerals from the ground: this may be a question of improved methods of mining, or it may be that improvements are to be sought in better recovery of the desired elements from the ores. The second is in new processes which may enable ores of lower grade to be worked profitably. The Lorraine iron ores are an example; when the rich deposits were nearly worked out and the ore beds seemed to be exhausted, the Thomas and Gilchrist process was devised and in a short time became the foundation of the great German steel industry based on low-grade ores. The cyanide process for the recovery of gold is a parallel example of the first method. The third approach lies in better means of dealing with scrap. Improved methods of collecting scrap such as have been applied by all belligerents during the war—not, of course, in its extreme form of compulsory seizure of our railings!—will cause less waste of scrap, while increased care in the segregation of different kinds of scrap will avoid loss of the rarer elements.

NOTES AND COMMENTS

Non-Ferrous Metals

THE series of Post-War Building Studies published for the Ministry of Works includes one entitled *Non-Ferrous Metals* (H.M.S.O., 1s.). Produced by a committee convened by the British Non-Ferrous Metals Research Association, it deals with both accepted applications and possible new uses of non-ferrous metals and stainless steel. The subject matter is arranged most systematically, and the ground is covered so comprehensively that it is doubtful whether more information could have been packed into the 72 pages to which the report runs. In presenting its recommendations the committee has performed a useful service by drawing attention to a number of techniques, materials, and finishes which are less used than their value warrants. Included in this category are the lead alloys superior to virgin lead, aluminium bronze, Monel metal, stainless steels, aluminium foil (as a heat insulator), metallisation, and galvanised steel siding. It is suggested that the use of matt-surface and textured metal could be exploited more widely than it has been in the past, while the great variety of colouring that is made possible by chemical and electrolytic treatments (*e.g.*, anodising of aluminium, B.M.A. finish of copper and brass, oxidation of copper alloys, self-colouring manganese bronze) is also emphasised. A number of useful suggestions are made as to matters requiring further practical trial or laboratory research, and metallurgists will do well to follow these up in practice.

Germany's Synthetic Oil

SYNTHETIC oil plants in Germany and the occupied territories have been attacked systematically by the British and U.S. air forces in recent weeks. These tactics, which are already having a tremendous effect on the enemy's transport system, culminated in the raid on Leuna, the biggest synthetic oil plant in Germany. In this connection an article which appeared some weeks ago in a leading Swiss paper makes interesting reading. After reviewing the historical development of the techniques involved in the synthesis of fuel-oil, the author reveals that most of the larger lignite-mining companies on the right bank of the Rhine have established, under the leadership of the Gelsenkirchner Mining Company, their own plants for the hydrogenation of coal. On an average, these produce a ton of motor fuel from each five tons of lignite. The whole lignite output of the neighbouring Geisel Valley, amounting to 30,000,000 tons, is being utilised at Leuna, the annual output of which is said to exceed the million-ton mark. At the Saale Waterworks near Leuna about 800,000 cu. m. of water are being used daily in the production of hydrogen for the hydrogenation process. The Gleiwitz works in Upper Silesia also produce over a million tons of oil a year.

Underground Factories

THE article states that several plants are wholly or partly underground and equipped with smoke-screen apparatus; for instance, the Blechhammer works in Upper Silesia are completely underground and are said to have withstood several air attacks. Germany's total output of synthetic oil is estimated at 10,000,000 tons per annum. With the dwindling of natural oil supplies from Rumania, Hungary, Poland and Estonia, the position is becoming critical, and as soon as Germany has to rely entirely on synthetic production then the loss of a single plant or even storage dump will cause enormous difficulties.

Toluene from Petroleum

THE development of toluene synthesis on a large scale has been, as *Chemical Industries* suggests, one of the major chemical accomplishments of the war, to be ranked alongside the production of synthetic rubber, aviation petrol, and penicillin. The preparation in big quantities of toluene from petroleum started in the United States just six weeks before Pearl Harbour at the $12,000,000 plant erected at Baytown, Texas, and operated by a company affiliated to the Standard Oil Company. In the following year two-thirds of the toluene used for making TNT in America came from that plant. The synthesis technique had its origins in the observation made by chemists in the Baton Rouge unit of Standard Oil that

significant amounts of toluene were formed in the course of an attempt to improve petroleum products by hydrogenation. A report on the possibilities of building the ring structure of toluene from straight-chain hydrocarbons was ready in 1933, and was passed to the Army Ordnance Department, which recognised the opportunity it offered of avoiding the shortage of toluene likely to occur in the event of war and asked for further experiments to be carried out. By 1935 toluene suitable for nitration had been obtained, and by the time Germany attacked Poland a product 99.7 per cent. pure was forthcoming. August, 1940, saw the first batch of 500 barrels on its way to the Du Pont explosive works for conversion into TNT. No official figures of war-time production are available yet, but it is virtually true to say that the entire increase in American output is coming from petroleum.

Science in the Canteen

AT a meeting of the Food Education Society held in London last week, some interesting points arose regarding the management of factory canteens. Sir Wilfrid Garrett, Chief Inspector of Factories, gave the conference a motto: "We must cater, not feed," and informed his hearers that, among the 17,000 industrial canteens now operating in Great Britain, the small canteens now continued to be the most favoured; in the very large ones, providing over 1000 meals, only about 30 per cent. of the workers took a full meal. Miss Cliff, manageress of a big canteen in London, provided a good instance of how scientific calculation can remedy defects of diet. The workers in her factory, who were engaged in heavy smelting, had persistently lost weight owing to the loss of salt when they got hot. Science came to the rescue, and provided a practical yet attractive solution to the difficulty. A tasty beverage containing much salt and plenty of fruit flavouring was supplied, and this became so popular that after three months the men were drinking a gallon of it a day, and all loss of weight was stopped. It is perfectly true that a little imagination, regulated by an adequate use of chemical knowledge, can add immensely to the comfort and satisfaction of people working under factory conditions.

Alginate Rayon

Affinity for Dyestuffs

OF particular interest in the lecture entitled "The Dyeing of the Newer Rayons," which Mr. C. M. Whittaker delivered to the London Section of the S.C.I. recently, was the passage dealing with alginate rayon. One of the advantages claimed for alginate rayon is that its production does not require the importation of raw material as it is obtained from seaweed, of which there is a plentiful supply, particularly in the Western Hebrides. While this is true, said Mr. Whittaker, it must be realised that the Western Hebrides are a considerable distance from our textile production centres. The other great advantage of alginate rayon and one which has a peculiar advantage in war time, is that it is fireproof, and this naturally points to a post-war use in curtains and hangings in public buildings in order to reduce fire risk.

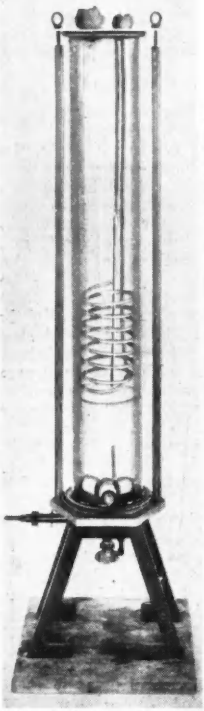
Alginate rayon may be produced with different metallic salts; calcium, chromium, and beryllium have been put forward by Professor Speakman, who has played a prominent part in the war-time development of this rayon. Calcium and sodium alginate rayon are soluble in soap, and Speakman has capitalised this weakness by using it as a binding thread during weaving, which binding thread may be subsequently removed by treatment with soap. This method can produce fabrics of a net-like structure by other than the normal method of carbonising the cellulose fibre subsequent to weaving. It will be immediately appreciated that treatment with soap is a very much easier and less dangerous form of removal of the unwanted fibre after weaving than carbonising.

Improving the Fastness

Chromium and beryllium alginates may be dyed with the mordant dyestuffs, but they have no affinity for cotton or acid dyestuffs. It has been shown by Wilcock that a pre-treatment of alginate rayon with "Fibrofix" (a product put forward by Courtaulds for improving the fastness to washing by after-treatment of direct cotton colours but which is not in present supply owing to war-time restrictions) gives the fibre a very good affinity for direct cotton dyestuffs and for the aggregated acid dyestuffs, and it gives an improved affinity for some mordant dyestuffs. Finally, the molecularly dispersed acid dyestuffs, Neolans, and acetate dyestuffs have no affinity for alginate rayon, nor does a pre-treatment with "Fibrofix" increase their affinity. Mr. Whittaker's address is published in full in *Chemistry and Industry* June 22, 1944, p. 269.

Production of Food Yeast

Teddington's Pilot Plant



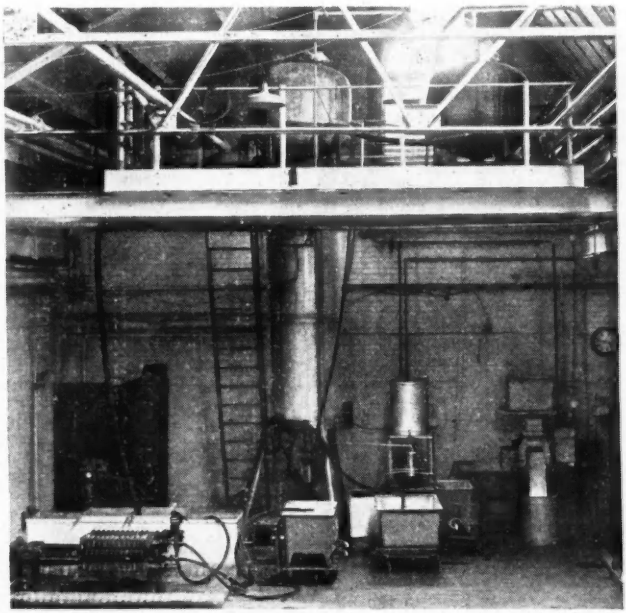


Fig. 1 (left). Vessel used at the Chemical Research Laboratory for the initial food-yeast investigations. Fig. 2 (right). Photograph of the pilot plant; details of its design are shown in Fig. 3.

DETAILS released last year about the production of food yeast at the Chemical Research Laboratory, Teddington (THE CHEMICAL AGE, 1943, 48, p. 249 and p. 260) stimulated a great deal of interest. To satisfy a widespread demand for more information about the process, Colonial Food Yeast, Ltd., the Government undertaking sponsored by the Colonial Office to exploit the process on the large-scale, has published a booklet on the subject, entitled *Food Yeast: A Venture in Practical Nutrition* from which the account that follows has been abstracted.

This publication takes pains to point out that there is nothing new about the deliberate and scientifically-inspired use of yeast as a foodstuff for men and animals. In the last war the Germans used it as a source of protein for human consumption; but then it was not a complete success probably because the quantities fed were too large. (As a regular part of a daily diet an amount of about ¼ oz. is recommended as valuable, though quantities of up to 3-4 oz. per day have been eaten without any untoward effects.) In this war the Germans are understood to be manufacturing and using some thousands of tons of food yeast a year, cultivating it on wood sugar prepared by the costly process of hydrolysing wood by strong acid. Here in Britain a similar interest has been taken in the possibilities of food yeast. Earlier in the war plans were laid to produce food yeast from molasses both in this country and in the colonies. It was for this purpose that the company called Food Yeast Co., Ltd., was formed by the Ministry of Food. However, the increasing stringency of the shipping situation and the consequent impossibility of importing the raw material required led to the abandonment of plans for production in the United Kingdom. The proposal remained to manufacture in the colonies, specifically in Jamaica, and it was decided, as this was a pioneer venture, to undertake it with the assistance of public funds provided

under the Colonial Development and Welfare Act of 1940. The Secretary of State for the Colonies made a scheme under this Act providing an interest-free loan of £150,000 for the Jamaica project. The West Indies Sugar Co., Ltd., was chosen to handle the scheme because their facilities enabled them to tackle the complete design, purchase, erection of the factory, to be sited at Frome in the Westmoreland County of Jamaica, and to operate in conjunction with the Frome Central Sugar Factory and Distillery. Factory output, it was decided, should start at 12 tons of dried yeast per day, the design of the plant allowing for extension afterwards. The Jamaica factory will operate on three 8-hour shifts, and the total personnel employed in one day will be about 100 including technical staff: a factory twice the size could be operated with little more addition to personnel, and those mostly labourers.

Laboratory Trials

The research work upon which the large-scale process is based was done at Teddington under the direcion of Dr. A. C. Thaysen, who provides a useful description of the investigations in the publication mentioned above. The yeast chosen for the project was the species *Torulopsis utilis*, and one interesting point has been the development from this species of a mutation, *T. utilis var. major*, a new strain obtained by special treatment of the parent species; cultures of this organism, which has a higher growth rate, may be secured from the Teddington Laboratories. This new variety is being used in the pilot plant investigations at Teddington.

The first necessity was to ascertain the growth rates and nutrition requirements of the yeast, and useful details are given by Dr. Thaysen of the apparatus used for cultivating the yeast in the earliest experiments. Briefly, this apparatus, a photograph of which is reproduced here (Fig. 1), consisted of a glass cylinder of 10 litres capacity mounted on an aluminium base into which were inserted ceramic porous blocks through which compressed air could be discharged, first through a cotton wool filter and thence into the liquid contained in the vessel, so aerating it and providing oxygen for the growing and dividing yeast cells. The base was fitted with an outlet tap for sampling and emptying. The top of the cylinder was perforated to hold two funnels through which the required food solution and ammonia solution respectively could be introduced, additions of these nutrients being made at intervals in order to keep pace with the rapidly increasing yeast population. The temperature of the growth liquor could be varied by means of an aluminium heating soil inside the vessel.

Full particulars of the experiments made using this apparatus are given in the booklet, which includes also a valuable table showing theoretical requirements of yeast for carbohydrates, nitrogen and phosphorus.

Pilot Plant Operations

Pilot plant production of food yeast at Teddington is carried out in the plant illustrated in Figs. 2 and 3. In principle, the growth vessel of this plant is identical with the laboratory vessel described in the previous paragraph. A yeast separator (Alfa Laval) has been added for the concentration and washing of the crude yeast, and also a set of drying rollers on which the washed yeast from the separator can be rapidly dried and converted into a light straw-coloured flaky powder with a slightly nutty or meaty taste. The wort used in the pilot plant is prepared from blackstrap molasses by diluting it with sufficient warm water to give the resultant wort a carbohydrate content of approximately 14 per cent. This solution is boiled in one of the cookers shown on the gantry. Before boiling, arsenic-free triple superphosphate is added to the extent of 2.4 kg. per 100 kg. molasses taken. This is then raised to boiling point by injection of steam and kept boiling for 30 minutes. Afterwards, for each 100 kg. of molasses taken, 2 litres of 0.88 ammonia is added to the solution, and this causes a heavy precipitation in the molasses solution, which on standing settles out within 2-3 hours. The supernatant liquid is then withdrawn as a clear solution. This is boiled for 30 minutes in the cooker and should by then have a total carbohydrate content of 10 per cent. If stronger, it is diluted with either boiled or chlorinated water. (This molasses solution is described as "strong wort," to differentiate it from "initial wort"—used to prepare yeast inoculum—containing 0.5 per cent. carbohydrate, and "dilute wort" with 4.5 per cent. carbohydrate. The latter is used during the continuous period of protein synthesis.)

Preparing the Culture Medium

Before proceeding with a growth experiment in the pilot plant, 7.5 gallons of strong wort are mixed in the growth vessel with 141.5 gallons of water that has been sterilised either by boiling in the vessel or by previous chlorination. To the liquor thus prepared is added a solution of arsenic-free triple superphosphate in sufficient strength to raise the phosphorus content of the wort to 0.006 per cent., and ammonia or ammonium sulphate is added to raise the nitrogen content to 0.024 per cent. Then the reaction of the wort is adjusted to *p*H 4.5 and its temperature raised to an optimum—30°C. in the case of *Torulopsis utilis var. major*. Injection of filtered compressed air is now started at the rate of 40 cu. ft. a

minute, and into the aerated dilute wort are introduced 1-2 gallons of a culture of the active organism; this culture should contain sufficient cells to give the wort *after inoculation* a cell density (population) of 100-200 million cells per millilitre.

Once the growth vessel has been filled to its maximum working capacity (300 gals.) as a result of the periodic addition of measured quantities of nutrient solutions, and continued over a very long period, possibly throughout a whole working week, provided care is taken to avoid infection of the wort with foreign micro-organisms.

The growth liquor withdrawn hourly is concentrated by passing it through a centrifuge, and the yeast suspension thus obtained is immediately washed with clean cold water until all but about 1 per cent. of the original wort has been removed from

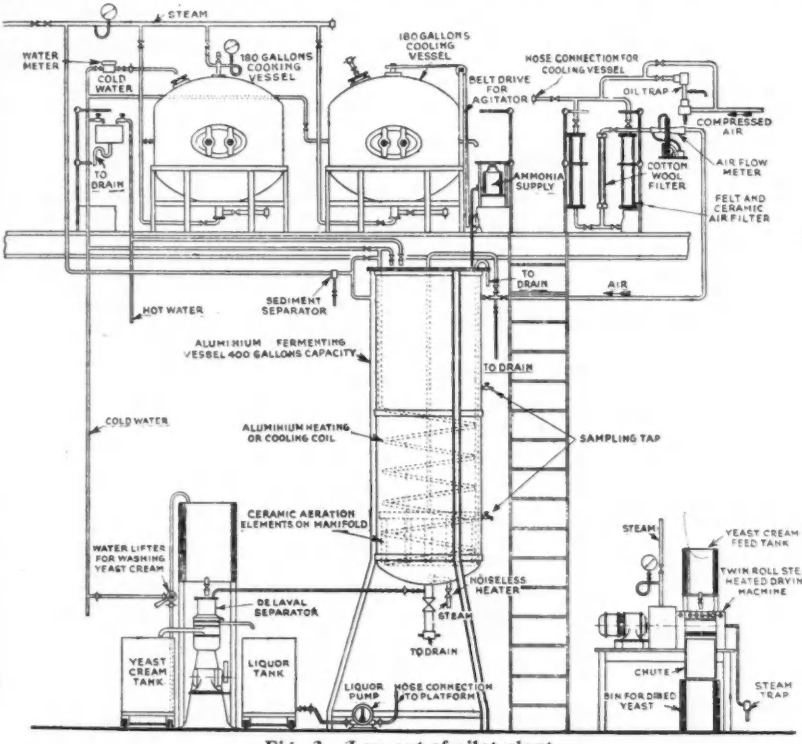


Fig. 3. Lay-out of pilot plant.

the yeast population has reached a density of 1200 million cells of *T. utilis var. major* per ml., 25 per cent. of its volume is withdrawn hourly through the centrifuge and replaced by 25 per cent. of dilute wort (containing 4.5 per cent. of total carbohydrates in solution). If nitrogen is added in the form of ammonium sulphate, it is essential to maintain the reaction of the liquid in the growth vessel at its optimum (*p*H 4.2-4.5) by frequent additions of a boiled and filtered solution of soda ash or sodium hydroxide in suitable concentrations. The hourly replacement of 25 per cent. of the total volume of the growth vessel can be it. The resulting yeast suspension or yeast cream is immediately passed over the steam-heated rollers from which it issues as dried food yeast containing approximately 5 per cent. of water.

The culture used for the initial inoculation of the growth vessel is prepared in the laboratory in the vessel shown in Fig. 4, the construction of which is in essence similar to that of the laboratory vessel first described, allowing intensive aeration of the seeded culture medium. The nutrient solution used here consists of initial wort prepared from blackstrap molasses and containing 0.5 per cent. carbohydrates in a

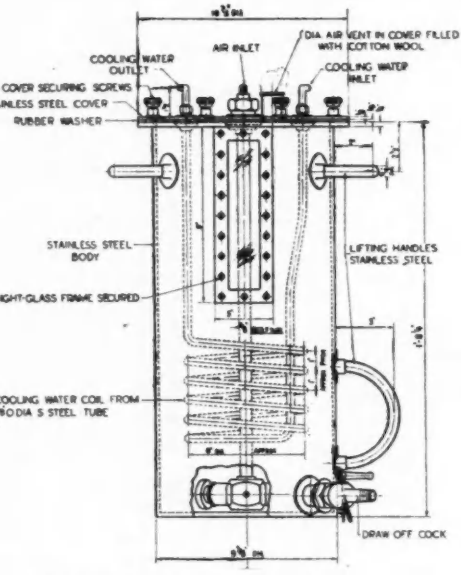


Fig. 4. Arrangement of yeast seed vessel.

volume of 50 per cent. of the total final volume of inoculant aimed at. The nitrogen and phosphorus content of the initial wort and their subsequently added amounts follow closely that indicated for the laboratory and pilot plant type of experiment. The reaction of the wort is adjusted to *p*H 4.2-4.5, and maintained at this figure by the periodical addition of 20 per cent. solution of 0.88 ammonia. This wort is inoculated with a pure culture of the test organism grown on wort agar slopes. Growth in the vessel is allowed to proceed until the concentration of cells has reached about 2400 million cells per ml. of wort in the case of *Torulopsis utilis*; for *T. utilis var major* the aim should be 1200 million cells.

Readers who are interested in the plans for the Jamaica factory (these are quite detailed, giving estimates, for instance, of power and fuel requirements, effluent disposal, shipment, etc., as well as an outline of the plant design and projected operation) should consult the booklet which is published at 2s. 6d. by Colonial Food Yeast, Ltd., Brook House, Park Lane, London, W.1.

The factory is designed to handle carbohydrate supplies in the form of molasses, sugar juice or raw cane sugar. The tanks for growing the food yeast will be ten in number, each 5 ft. 2½ in. diameter by 24 ft. high and made of stainless steel. There will be 32 Aerox aeration candles to each tank. For aeration, air will be provided by four compressors, each of variable speed with a capacity of 100-250 cu. ft. free air per minute. The yield of fermented wort will amount to about 4500 gallons per hour, containing 2.4 per cent. dry yeast. Six DVK 6 separators made by DeLaval Separator Co., each driven by a 10 H.P. motor, will give sufficient capacity to allow 100 per cent. standby. The spent wort will run to a sewer. Steam for drying at 25 lb./sq. in. will be exhaust from the turbines of the sugar factory. It is hoped to produce bagged yeast at a cost, *ex* factory, of about 6d. per lb. when using molasses as the carbohydrate supply, and when producing 2500 tons of yeast a year.

SWEDISH SYNTHETIC FUEL

According to the Stockholm press, experiments have been going on for some time at a pulp mill in South Sweden on the extraction of liquid fuels from sulphate lyes. The experiments, based on a high-pressure method, are said to have turned out satisfactorily, and if State support can be obtained, a plant will be built with an output of 925,000 litres a year. The new products, mainly acetone, higher ketones and alcohols, and aliphatic and aromatic hydrocarbons, as well as organic sulphur compounds, are stated to have calorific values of between 6700 and 9700 kg./cal., and an octane number of 90 to 92. Up to now the sulphate lye has been used as dust-laying material in road-building.

HIGH-SILICON IRONS

A paper (RP1581) by P. Hidnert and G. Dickson in the April *Journal of Research* gives data on the linear thermal expansion of a high-silicon cast iron containing approximately 14 per cent. silicon with 33 per cent. molybdenum, and of a similar iron without appreciable molybdenum, at various temperatures between 20° and 700°C. Differences between their coefficients of expansion were slight. Both were found to have slightly higher coefficients of expansion than electrolytic iron for temperature ranges between 20° and 300°C., and appreciably higher coefficients for higher temperature ranges. No indication of growth similar to that of ordinary cast iron was observed on heating the high-silicon cast iron to 700°C.

South African Vermiculite

Government Research

IN view of the increasing number of uses that are being found for vermiculite, the development of deposits of this mineral in the Transvaal are being watched with special interest in the Union of South Africa. The Government Metallurgical Laboratory, in particular, has, during the last seven years, examined locally-produced samples in the fullest detail from an economic viewpoint. The results of these researches have been embodied in a recently-published bulletin, which covers the whole field of vermiculite technology in its widest sense.

The vermiculite deposit at Palabora in the north-eastern Transvaal, near the confluence of the Selati and Olifants rivers, is of especial interest. It covers an area about three-quarters of a square mile in extent, and has been proved in places to a depth of at least 80 ft. The deposit is now being developed by two companies, the Transvaal Ore Company, Ltd., and Vermiculite (Proprietary), Ltd. Deposits of vermiculite, said to be of considerable size, have also been reported recently in the Duivelskloof district of northern Transvaal.

The ore as mined at Palabora is mixed with more or less pyroxenite, serpentine, calcrete, and interfoliated chalcedony, from which it must be freed to render it saleable. In addition, if the best results are to be obtained, vermiculite must be used in the form of relatively uniform-sized material. Even where various sizes may, with advantage, be mixed together in definite proportions for special purposes, the best characteristics are normally only obtained by performing the sizing and preparation within definite limits of accuracy.

Grading Process Developed

The Government Metallurgical Laboratory, after examining the various methods used or suggested elsewhere, has developed a process which includes not only the production of clean vermiculite but the preparation of closely-graded products suitable for direct utilisation by the ultimate consumer. Apart from cleanliness and accurate grading, the most important feature of properly prepared material has been found to be related to the equidimensional measurements of the individual particles after expansion. Expanding has practically no effect on the edge-to-edge dimensions of the flakes, so that the thickness of the flakes should be selected in such a way that, after expanding, the flake, if originally approximately square, would approach a cube. Material conforming as closely as practicable to this condition is much superior in several respects to an equally closely-graded and gangue-free product not selected or "classified" in this manner.

Plastics Development

More Experts Demanded

AT the annual general meeting of Thomas La Rue & Co., Ltd., last week, the chairman, Mr. B. C. Westall, had some constructive remarks to make concerning the position of industrial research workers in the immediate future. Speaking of the progress made by the subsidiary company, De La Rue Plastics, Ltd., he stated that the policy of enlarging the research and development departments had been continued.

"During the war," he said, "our activities have been restricted to finding new applications of plastics to war purposes. Even more could have been done had we been able to obtain sufficient technical staff with the necessary qualifications for carrying out research. It is to be hoped that the Government will bear in mind this desirability of making available for industrial concerns at the earliest moment possible experts in chemistry and engineering, so that the ground-work for industrial expansion may be prepared in good time. In a comparatively new industry such as plastics, research and development are even more important than in the case of the older industries.

Mr. Westall went on to say that the future expansion of plastics business would depend on the speedy relaxation of the system of controls. Industrialists realised the necessity for a strict control of raw materials in war time, and he was of opinion that the controls had functioned fairly and efficiently. It was, however, an unhealthy condition of affairs when one manufacturer was unable to acquire new plant because some other manufacturer had plant that was partially idle. Such procedure tended to subsidise inefficiency. He hoped that the system of purchase of plant by licence might be speedily abolished.

PATENT LAW REFORM

At last week-end's meeting of the Manchester section of the Royal Institute of Chemistry, Mr. H. E. Potts, the Liverpool patent agent, spoke on the need for reform of the patent laws. He said that in his experience the alleged practice of "freezing" patents had been grossly exaggerated, and that many of the so-called "blocking patents" would be prevented if Patent Office officials were given the power to reject trivial applications lacking real invention. He suggested that a good ground for granting a compulsory licence of right would be that the applicant had a genuine invention which he was prevented from exploiting because of the existence of a patent held by someone else. In his view a special judge with scientific knowledge, and a new High Court tribunal, should be appointed.

Personal Notes

MR. HAROLD LEONARD SAUNDERS has been appointed Comptroller-General of Patents, Designs, and Trade Marks, in succession to SIR FRANK LINDLEY, who retires on August 31.

DR. NORMAN ALLEN, of the Research and Development Laboratory of the Mond Nickel Co., Ltd., has been appointed to fill the vacant post of superintendent of the Metallurgy Division at the National Physical Laboratory. He will take up his duties on September 1.

DR. E. W. SMITH, C.B.E., has resigned his position as technical director to the Woodall-Duckham Vertical Retort and Oven Construction Co. (1920), Ltd., and his other directorships in the Woodall-Duckham group with which he has been associated for over 24 years. It is understood that he proposes to devote himself to public work.

MR. A. F. G. CADENHEAD has become director of the Department of Chemical Development which Shawinigan Chemicals, Ltd., Canada, has just established. Since 1929 he has been director of plant research for this company. Assistant director in Shawinigan's new department is MR. P. W. BLAYLOCK, who was formerly supervisor of the anhydrite plant at Shawinigan Falls and then development engineer for plant and equipment design.

Obituary

SEC.-LT. NEIL ANTHONY CLELAND DUNNING, who has been reported killed in action in Normandy, was before the war a chemist with the British Sugar Corporation at their Prestonhall Factory, Cupar, Fife.

MR. WALTER BAYLY WOODLAND, controller of chemicals for the Canadian Department of Munitions and Supply, died at his home in Westmount, Montreal, on June 11. Born in Norfolk, England, he was educated at Leicester. Before going to Canada in 1915 he was employed at Boots Pure Drug Co., Ltd. In Canada he represented Hough-tons, Ltd., and was later Montreal manager of the American Druggists' Syndicate. He was a member of the Society of Chemical Industry.

SIR RALPH FOWLER, O.B.E., F.R.S., who died at Trumpington, Cambridge, on July 28, aged 55, had been Plummer Professor of Applied Mathematics at Cambridge since 1932. His researches at the Cavendish Laboratory and elsewhere were of signal importance to applied physics; and in 1938 he had been appointed director of the National Physical Laboratory when a sudden illness made a change of employment inadvisable. Next year, however, despite poor health due to a severe wound from the last war, he threw himself with energy into war work, and organised the scientific liaison between Britain and Canada, later extending his activities to the U.S.A. His wife, who died in 1930, was a daughter of Lord Rutherford. In 1936 he was awarded the Royal Medal of the Royal Society, and he was knighted in 1942.

Tartrate Recovery

Use of Base Exchange Resin

SYNTHETIC anion exchange resins are capable of recovering 85 per cent. of the valuable tartrates formerly lost in the treatment of grape winery waste liquor at a chemical cost of less than four cents per lb. and at the rate of almost 5 lb. of acid per cu. ft. of exchange material. This claim is made by the U.S. Department of Agriculture on the strength of results obtained in its Western Regional Research Laboratory from a series of experiments conducted with Amberlite IR-4, an anion exchange resin developed by the Resinous Products & Chemical Co., of Philadelphia, and used for some time in water conditioning, and in the purification of formaldehyde and pectin.

The calcium tartrate is precipitated from the sodium chloride regenerant solution by means of calcium chloride. This process yields calcium tartrate of excellent purity, and recovery amounts to 85 per cent. or even more in the case of dilute slops. In the trials carried out at the Regional Laboratory it was found possible to perform 150 successive exchange cycles without loss of operating efficiency.

Tartrate occurs in brandy-still slops as a very dilute solution and is accompanied by large amounts of extraneous materials, among which other acids and salts, pigments, and colloidal matter are the most prevalent. To recover a tartrate of high purity in satisfactory yield, it is necessary first to separate the tartar and then to concentrate it so that calcium tartrate can be precipitated in sufficient quantities to make the process economically practical. Both ends can be attained through the use of an anion exchanger which is placed in beds similar to filter beds. When brandy still slops are passed through the exchanger the tartrate remains fixed to the resin while most of the unwanted material passes through as waste. When the exchanger bed has attained a capacity load, a solution of sodium chloride is passed through it to remove the tartar as a sodium tartrate solution of about 5 per cent. concentration. At the same time the sodium chloride solution prepares the bed for another adsorption cycle.

Metallurgical Section

Published the first Saturday in the month

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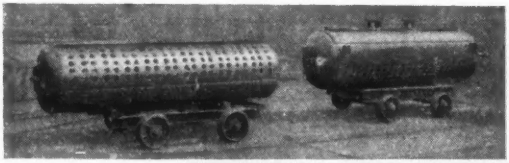

Drums for Water Tube Boiler

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Sludge Heater for Sewage Treatment

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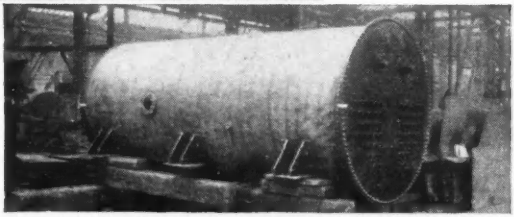

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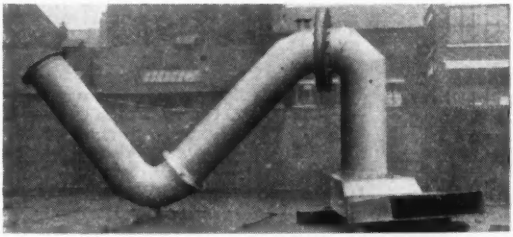

Large Diameter Welded Pipes for Chemical Works

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Group of Mild Steel Pressure Filters

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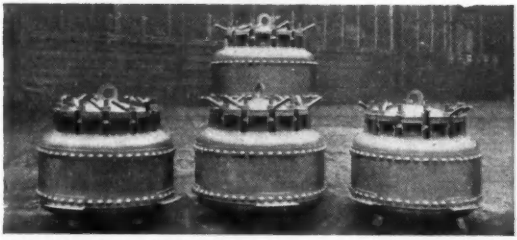

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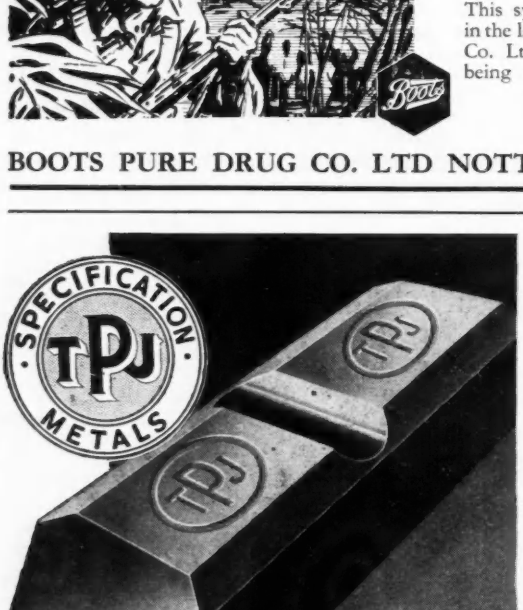

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Metallurgical Section

August 5, 1944

Recovery of Zinc

Procedures with Spent Copper Extraction Liquors

by A. G. AREND

THE recovery of zinc from the spent liquors of wet copper extraction is a subject upon which much experimentation and research has been carried out, although comparatively few of the results appear to have been published. This is partly due to the widely varying nature of the ores initially dealt with in the regular copper extraction process involved, and partly to the fact that the zinc-reclamation methods were always in the stage of being further improved upon. Not a few of the systems carried out on the Continent were for ores and residues which contained up to as much as 6 per cent. of zinc, whereas most of the poor copper ores worked in this country rarely contain more than 1-2 per cent. of this metal. Where appreciable zinc existed, it was a paying proposition to alter the process considerably, as regards both the roasting and the ultimate wet extraction. This practice did not always suit where the total copper available for recovery was correspondingly small, largely because extra plant of greater capacity, and more labour and attention were necessary, while many of the poor copper ores worked in this country did not justify the expenditure, particularly as the zinc content fluctuated appreciably.

For ores and residues which contained a sufficiently high zinc percentage, the whole roasting procedure could be altered, *e.g.*, by applying a purely sulphatising roast, but this system made no provision for the small silver content which was present, as the sulphate of silver is practically insoluble. Without the assistance of a chloridising roast, all the gold and most of this silver remained in the insoluble residues, which meant that the processes devised by Hofmann, Hiberts, and others were intended for use only where precious metals were absent.

Precious Metal Residues

In view of the closer examination which is to-day made of all raw materials, and the cheaper methods of extraction, efforts are made to recover the silver and gold contents, however small these may be; hence many of the earlier roasting methods had to be abandoned. Apart from this, several of the zinc separation processes depended on a final mixing of the resulting liquors with sodium chloride to convert zinc to the chloride condition, and accordingly there was nothing to lose in chloridising roasting from the aspect of actual zinc treatment. Works engaged on these processes are placed with advantage on ground that has a natural slope, as this minimises the amount of pumping of liquors, which otherwise would reach prodigious dimensions. Much time has to be devoted to accurate selection and location of pumps best suited for the work, and different forms of reciprocating and centrifugal pumps are employed. This will be better understood when it is mentioned that deep wells are purposely sunk for liquor storage purposes, apart from the use of capacious bins. Provided that a good pumping system is available, a better means of mixing and rearranging weak and strong liquors is thus obtained, and there is no risk of tanks remaining empty.

The Wet Extraction Process

The ores and residues which are to be dealt with for the extraction of copper, gold, and silver, are finely pulverised, mixed with a fixed proportion of common salt (usually of the rock-salt variety) and roasted in mechanically-stirred, gas-fired roasting hearths. When it is known that zinc is to be recovered, additions are made of other zinc-containing residues collected from outside sources. As some of these do not always respond to the treatment, efforts are also made to wash the zinc out slowly, by placing the material in the form of coarsely ground masses along the bottom of lengthy chutes, where the copper liquors pass. The gases evolved from the roasting, chiefly sulphur dioxide and chlorine, are absorbed in coke-lined towers to form a crude acid solution, suitable for assisting the extraction. Sulphur trioxide and hydrochloric acid are also present in the gases, and the resulting liquor is of a variable composition, while also containing metallic salts. At times much of the zinc becomes chloridised, and being of a volatile order at the roasting temperatures maintained, tends to pollute the acid liquors, and it is partly for this reason that the washing method was re-

sorted to. Where the ore contains under 1 per cent. of zinc, no change of procedure is necessary, but where from 4 to 5 per cent. occurs, the acid liquors formed require to be carefully controlled.

The roasted ores and residues are removed from the furnaces in tilting trucks or bogies, although in some instances skips suspended from monorail tracks are also used. The tilting truck suits best where batteries of tanks are located in one straight line, above which a rail track is purposely constructed. In order to expedite solution, the lixiviation tanks are equipped with false bottoms in which heather and similar materials are placed. The roasted ground mass is then exposed to the action of the hot acid liquors, and which is continued until a Twaddell figure of about 30° is reached. When much zinc is known to be present, a higher concentration may be safely aimed at, but care has to be taken that metallic salts are not present in sufficient quantity to crystallise out when stored in the wells, or wooden bins.

After the mass has received the full lixiviation treatment, hot water is pumped over it, and the wash liquors are retained for enriching with the next batch of material. The strong liquors contain almost the entire copper, zinc, lead, and silver contents, together with a quantity of iron and sodium salts. Lead and silver are retained in solution because of the excess of sodium chloride present, but as sulphates are also present, when once the liquor has been cooled down, the lead tends to separate out. For this reason the liquor is run to settlers, or tanks lined with glazed slabs, where it deposits a dirty white sludge tinged with red from the iron salts present.

Handling the Enriched Liquors

The liquors at this stage have been enriched to a concentration of about 42° Twaddell, and are pumped to the silver department for treatment with dilute iodide solutions. This causes the silver to be accurately precipitated as the insoluble iodide, which is treated with galvanised iron scrap for the recovery of the iodine salts. Alternatively, they may be treated with sodium sulphide. During this action the soluble zinc salts present exert no harmful influence, and the green liquors are run off to the copper precipitating house, which is equipped with square-sectioned tanks, furnished with pumps, siphons, and a heating arrangement in the form of steam-jacks, or in some cases, direct steam pipes. Where direct steam heat is supplied in this way, the liquors tend to become diluted, and it is necessary to see that the precipitation is not unduly held up, otherwise excessive dilution might obtain. This is of little account where the ordinary precipitation of copper is practised, but for the subsequent zinc separation it means that much greater evaporation and tank space is demanded.

Although descriptions have appeared of methods of specially precipitating the copper with iron prepared for the purpose, it has been found that thin or light scrap iron, does the work quite well, while galvanised iron performs the deposition most rapidly. From the point of view of recovering the zinc ultimately, scrap zinc might be imagined to be most suitable, but in practice it has been found that this system is more expensive, while the scrap cannot always be obtained in sufficient quantity, though otherwise the method is excellent. The acidity and heat of the liquor decide the rate of dissolving the metallic iron and zinc, and accordingly determine the rate of deposition of the copper. In one arrangement, when certain batches of liquor were known to be already rich in zinc, galvanised iron was immersed only until the zinc coating had been removed, and was then replaced by fresh scrap. By this means, the iron content was reduced to a minimum, while the remaining scrap could be consumed later for ordinary copper liquors, whereby the resulting solution comprised sulphates and chlorides of zinc and sodium.

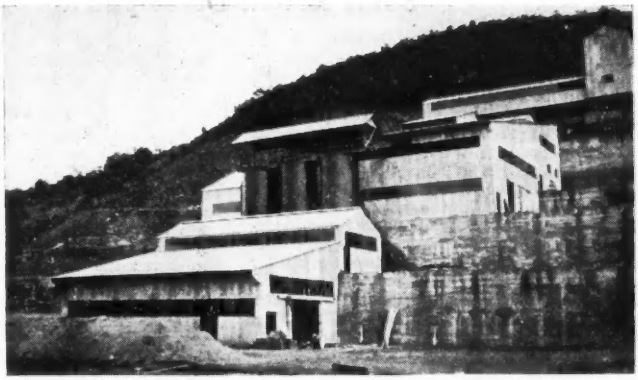
When copper is precipitated from zinc-free ores and residues, the usual practice is to run the liquors to waste. This has the disadvantage that in certain districts exception was taken by the local authorities to acid solutions corroding the iron drain-pipes: as a result a ruling was made that a certain proportion of lime had to be charged, thus adding to the cost, and giving nothing in return. When the zinc has been recovered, this acidity is no longer apparent in the same way, hence no such provision is necessary.

Ultimate Recovery of the Zinc

The process is varied slightly to accommodate an increased zinc content, mostly at the initial stages. Thus, selected residues containing sulphides are allowed to weather before mixing with others for the roasting process, while an alternative is to utilise crude ferric sulphate in the lixiviation liquors, whereby the most complete extraction of the zinc is obtained.

This crude ferric sulphate is prepared by heating the residual iron material from the tanks in iron pots with concentrated sulphuric acid. By dint of keeping the iron pots enclosed and free from moisture, and using strong acid only, the corrosion of the pots is relatively slight. In the zinc liquors for treatment, if the iron content has been allowed to reach too high figures, owing to the use of overmuch scrap iron in precipitating the copper, the economic extraction of the zinc is rendered unduly complicated. A small percentage of iron can be separated by an emulsion of zinc oxide,

but should iron predominate, a great excess of this material is necessary. This system was therefore abandoned, as the iron mud contained this excess, which was literally worthless, as it was of so variable a composition that it could not be incorporated in pigment production. When iron is absent or has been separated, lithopone can be prepared by addition of barium sulphate solution.



Lay-out of a metallurgical wet-extraction plant, taking advantage of a natural slope to minimise pumping operations.

More success was attained by evaporating the liquors under specific conditions whereby zinc chloride and sodium sulphate separate out. The earlier practice of evaporating the liquor, following iron separation, to a concentration of 106° Twaddell was found to be at fault, and no good discrimination between the two salts could be made, because of the formation of the double compound of zinc and sodium. This was succeeded by evaporating to a Twaddell concentration of 64°-72° in the cold condition by means of a vacuum, but nowadays the evaporation is carried out in an evaporator directly, and is claimed to make a reliable separation, whereby crystals of sodium sulphate separate out, and leave a liquor of practically pure zinc chloride. This product is utilised directly in liquid condition, and when fully evaporated, for a wide range of industries, for soldering fluxes, vulcanising, wood-preserving, disinfecting, etching, sizing, for dentrifices, for candle manufacture, and in the production of artificial silks, and paper. Yet until quite recently these liquors from wet copper extraction were allowed to pass down the drain without any attempt at recovery! Where richer zinc residues are available, the original addition of common salt is increased to 20 per cent., and the roasting performed at from 600°-650°C. in order to ensure a good extraction.

Attempts at direct electrolysis of the waste solution met with no success, as the predominating sodium salts interfered with the deposition, and it was found necessary to crystallise them out as before. When this is done, the remainder of the process is comparatively simple, although it has been found best to perform the crystallisation at −0.5°C. Diaphragm cells with revolving disc-shaped cathodes were used at 9 amp./sq. ft., with voltage representing 3.6 volts, and gave zinc of more than 99.9 per cent. purity.

One further advantage of operating this process in conjunction with wet copper extraction is that all chlorine evolved from the cells is utilised in enriching the acid liquors, thus ensuring a more rapid means of recovery.

Production of gas coke in the United States in 1943 amounted to 862,104 net tons, according to the Bureau of Mines. This represented a decrease of 30,448 tons compared with that in 1942. The production of 19,848,868 gallons of crude tar indicated a recovery of 13.82 gallons per ton of coal carbonised, compared with 13.86 gallons in 1942. Ammoniacal liquor was produced at six plants in 1943, and the total quantity recovered in terms of NH_3 content was 1,341,896 pounds.

Reports have been prepared by the Geological Survey, U.S. Department of the Interior, Washington, of the iron-copper deposits of the Rich Hill area, Prince of Wales Island, Alaska, and of the zinc-lead mines of the Pine Creek district, Northern Idaho. The Alaskan ores appear to contain 1-1½ per cent. of copper. The Idaho mines are reported to have a reserve of 500,000 tons of minable ore at current war-time prices. Production of 850 tons daily has been attained.

C

Metallurgical Progress and the Chemist

Some Recent Developments

MUCH secrecy surrounds some of the most fascinating metallurgical developments of recent times, but in the following notes an account is given of such of the less private developments as will prove interesting to the industrial chemist. It should be borne in mind that a new process or material is often, in its early stages, suggestive rather than explicit, and the reader should study the notes that follow from this point of view. Many new applications of a metallurgical or scientific discovery are of primary importance only after a worker in another field has assessed and perceived their applicability to his own line of work. It is in this spirit that this article should be read.

It has, for example, been discovered by an American chemist that if single drops of metallic materials are fed on to a smooth, refractory heat-radiating surface in a hot closed chamber in such a way that the whole surface of the metal is subjected to heat by radiation, metallic vapour is discharged and condensed. It is designed to produce extremely fine powders of metals from these superheated vapours.

Four new aluminium alloys have been introduced. These retain their tensile strength when subjected to high temperatures, and have a high beryllium content. A method of using low-grade iron ores has been invented. This comprises a preliminary crushing, followed by fine grinding in a ball mill; the ground product is separated by a process of wet magnetic separation, after which it is briquetted or sintered. Vibrating screen separation is combined with the wet magnetic separation.

Chromium Plating

A new process of chromium plating increases the service life of tools made from high-speed steel containing up to 0.6 per cent. carbon. The edge of the tool is ground sharp in advance of the plating operation, so that once the plating has been applied, no additional finishing work of this type is required. Half-a-minute's etching in hydrochloric acid is given, after which cleaning by an electrolytic process follows. Lead is recommended as the anode in the plating operation. Each gallon contains 33 oz. of chromium trioxide dissolved in water, plus 0.33 oz. of concentrated sulphuric acid. The bath is operated at 60°C., with a potential of 3.5-5 V. and a current density of 1.5-3.5 amp. per sq. in. according to the material and the form of the tool. The plating is tough, and excellent adhesion is provided by a heat-treatment following the plating, in which the plated tool is immersed in an oil bath for 60 mins. at 176°C.

Bonderising

A new process known as bonderising is designed to render iron and steel more suitable for organic finishing. The process is essentially a phosphatising process, and does away with the difficulty experienced when enamel flows away from sharp edges, so that on thin sheets it enables the enamel to cover the edges completely. Moreover, when overlapping areas occur, as with folded seams, no injurious chemicals are retained in the seam, as may happen when sheets are electroplated. The oxide stain set up by resistance-welding or flame-welding need not be eliminated in advance of the treatment, nor is the removal of oxidating scale necessary. No special primers or underlayers are needed, and a single finishing medium alone suffices.

Three methods of producing a black finish on steel are of importance. In the first, the steel is cleaned and pickled, then immersed in a concentrated alkali bath at about 145°C., and a uniform finish comprising iron oxide (Fe_3O_4) is obtained after 10 minutes. The second method is phosphatising, as outlined in the earlier paragraph, and the third comprises coating the steel with zinc by one of the normal methods, after which the zinc is blackened by immersion in a proprietary solution. No additional resistance to corrosion is provided by this method, but an excellent surface for painting is obtained.

Rotary cement-making kilns are being adapted to the production of sintered iron ore. The ore to be sintered is mixed with an "agglomerating agent" manufactured by grinding a mixture of iron ore and limestone in a mill. Both ore and agent are then fed into the kiln, and as the mixture passes through this, it attains a temperature above the softening point of the mixture, but below the fusion point of the ore. The particles of iron ore are thus bound together to make up nodules.

A satisfactory refractory material, resisting the attack of slags obtained when iron is desulphurised with soda ash, has been produced by mixing a highly calcined flint clay with a high-grade bonding clay.

Dry Cyaniding

An interesting process for case-hardening is dry cyaniding, which is carried out in a furnace or muffle in an atmosphere

of neutral producer or town gas or coke-oven gas to which anhydrous ammonia is added. A typical plant for this process operates at 845°C. with approximately 700 cu. ft. of producer gas per hour to which are added 5·25 cu. ft of propane and 50·150 cu. ft. of ammonia per hour according to the case depth desired. Small parts are loaded on to low-sided perforated trays and pushed through the furnace. A case depth of 0.007 in. minimum is obtained in 1½-2 hrs. More ammonia and slow cooling will abbreviate the time required.

Steels are being treated with ferrous alloys containing boron and titanium. Hardenability is increased, there is no reduction in tensile strength, toughness is improved and ductility remains unaltered. The advantage of introducing these ferrous alloys is that they enable the same or superior properties to be obtained as would be conferred by the addition of, for example, 0.2-0.25 per cent. of molybdenum, or larger amounts of other alloys, *e.g.*, silicon and manganese.

Synthetic Scrap

Synthetic scrap is being produced in the United States by a direct reduction process. Ore, limestone, and carbon in the form of coal, coke, or oil coke, in the proportion 40 : 8 : 5, are dried, crushed to about 1/16 in., mixed intimately, and fed into the upper end of an inclined rotary kiln. A reducing atmosphere in the kiln enables the solid carbon to reduce the ore. The silica in the ore combines with calcium to form silicates. Lower down the kiln, the material is impregnated with additional carbon, sintered, and discharged into a vertical cylindrical melting furnace. Carbon additions to suit requirements are made directly to the metal below the slag in the furnace, which is basic, having over 40 per cent. lime. A carbon monoxide flame maintained above the slag reduces iron oxide.

"Martempering" is a new method of quenching steel, designed to prevent distortion and residual stresses. The quenching medium is usually a molten salt bath giving a minimum temperature difference between the outside and the centre of the part when the outside reaches the temperature for martensite formation. The piece is maintained in the salt bath long enough for the heat to be uniformly dispersed, and air-cooling follows.

A metal degreasing system first degreases with trichlorethylene vapour, and afterwards with a concentrated shower of the condensed solvent, which condensate is so treated that it carries no grease picked up from earlier operations. A better coating of tin on steel strip is being produced by the application of high frequency current, which melts the tin coating on the strip and produces a thinner and more evenly distributed film. Coils of strip may be electrolytically tinned at speeds up to 500 ft. per min., and inductor heating coils bring the strip temperature up to 232°C. within 0.7 sec. after the strip enters the coil. Strip passes from the inductor coil through a water quenching tank. Corrosion-resistance of the tinned strip is improved, since the tin is liquefied and, by flowing, fills up porosities. Tin is also conserved.

Nitric Acid Test

A nitric acid test is being employed for the assessment of the corrosion-resistance of stainless steel. It comprises establishing the loss in weight of a prepared test-piece after five successive 48-hr. periods in boiling 65 per cent. nitric acid. The weight loss is converted by a factor into a corrosion rate expressed in inches of penetration per month.

Thin, closely-adhering films or coatings on iron tubes are being produced, and have the effect of rendering the tubes capable of withstanding the attack of water containing calcium carbonate, while possessing a high thermal conductivity equal to about 90 per cent. of that of iron. The tubes are first phosphatised, and then treated with water filtered through an aggregate composed of a mixture of calcium carbonate and magnesia. Condenser tubes can be produced in this manner.

When a galvanised steel structure has been welded, the effect is to destroy the zinc coating close to and at the weld. A means of regalvanising these areas is as follows. While the joint is still almost at the welding heat, it is scrubbed with a wire brush, after which the joint surface is rubbed with a bar of a galvansing compound having a low melting point. The molten compound is then spread uniformly over the heated surface with the same wire brush.

Experiments have been carried out in Germany to decide on the best type of stainless steel to withstand the attack of nitric acid. Steels with 0.1 per cent. of silicon appear to be far more resistant than those with 0.5 per cent. of silicon, and in consequence it is suggested that silicon in the austenitic chromium-nickel 18-8 stainless steels for resistance to nitric acid should be very low in silicon or entirely free from this alloy.

Small Steel Tubing

A means of manufacturing small-diameter steel tubing has been invented. The raw material is cold-rolled steel strip from 0.008 to 0.042 in. in thickness, the edges of which are bevelled in a broaching machine. The spool of bevelled strip is first mechanically wound into the form of a spiral tube, and then this tube is fed into a high-frequency induction brazing furnace in which the spiral seam is brazed in a neutral atmo-

sphere. The red-hot tubing is cooled in a special chamber within which is a tension device that applies pressure on the brazed seam while the joint is still plastic. Finally, lengths are cut off to requirements and tested.

Submerged Pickling Burner

A completely automatic submerged burner for heating pickling baths enables the bath temperature to be maintained within an extremely narrow range. Acid-resisting equipment is now available with a guaranteed life of twelve months and an anticipated service life of two years. High thermal efficiency and saving in acid and in over-all pickling time render the equipment fully economical. A new metal coating process comprises cleaning, fluxing, and preheating wire or strip by passing it through a bath of molten salt in advance of its entry into the metal bath of zinc, babbitt metal, cadmium, or tin.

Research into cast iron for glass moulds has been going on in an endeavour to find a metal in which cracks would not form in that part of the surface alternately heated and cooled by the hot glass and its removal. It appears that an annealed chill-cast alloy iron containing chromium, nickel, and molybdenum gives the best results. It is rather more liable to crack than a sand-cast iron of identical composition, but the sand-cast iron will not take a sufficiently high polish.

Seamless Steel Vessels

Large seamless steel vessels, up to 6 ft in diameter and 60 ft. long, are being made by rolling in radially arranged sets of rolls which act on both the inner and outer surfaces of the hollow shell. Longitudinal movement of the piece through the mill is obtained by setting the axes of the rolls obliquely to the longitudinal axis of the piece.

A new crack-detection process is based on the fact that certain materials are fluorescent when exposed to ultra-violet light. The test-piece to be inspected is immersed in a special bath of fluorescent material maintained at 75°C. Withdrawn after a brief period, it is washed in a solution designed to eliminate all fluorescent matter from the surface. If there is a surface crack, the fluorescent material remains wedged in it, and as soon as the test-piece is subjected to ultra-violet light, the crack shows up with great vividness against a black or purple background.

Experiments on the correct metals to use for acetic-acid resistance have established that silver, tantalum, platinum, and an alloy steel containing 26 per cent. chromium and 4 per cent. molybdenum offer the greatest resistance to the acid at all temperatures. Straight chromium irons show higher resistance in proportion as their chromium content increases, but the introduction of nickel lessens the resistance, while 18-8 stainless steel shows lower resistance as carbon percentage increases. Resistance, however, increases if molybdenum is introduced.

Building blocks have been manufactured from crushed rock quicklime and waste pickling liquor. A more recently developed method of treating the slurry formed in the early stages of this process in a high-pressure board-press enables plaster boards to be made, suitable for internal walls.

Refrigeration of Steel

Advantages of Sub-Zero Treatment

CURRENT development of mechanical refrigeration systems in America has revived interest in the cold treatment of metals. At present the range of temperatures used is between −62° and −90°C. According to G. B. Berlien, chief metallurgist of the Lindberg Steel Trading Company, Chicago, one of the newest applications of sub-zero treatment is to high-speed alloy steel of the standard 18-4-1 variety, either with or without cobalt, and also the newer molybdenum types. High hardness is introduced with improved ductility. Treating such material with a temperature of −79°C. causes no apparent change in microstructure, but there is a change in the magnetic properties, which are improved, and an increase in size as well as in hardness.

High-speed steel tools are first hardened in the usual manner by heating up to 1260°C. in two or three stages, then quenching in oil, lead, salt, or air until the temperature has dropped to at least 93°C. A continuous cooling rate must be maintained without fail while reducing the temperature in the refrigerating machine to −79°C., below which temperature no apparent advantage is to be gained. It is sometimes advantageous to slow up the cooling rate by wrapping the tool in paper, but the main point to be observed is that the cooling rate must be continuous.

The purpose of sub-zero refrigeration of alloy steels is to complete the transformation of austenite into martensite. This transformation is adversely affected if the tool is left in the air 30 hours or more after hardening. Following the cooling cycle, which takes about six hours, the tool is allowed to come to room temperature normally. It is then tempered or drawn at 540° to 595°C. to produce the desired hardness. It is possible to give the tool a double draw, in which case refrigeration is necessary before each draw. The percentage of cracked tools from this treatment is extremely low, even though they are of intricate shape.

Copper Powder Metallurgy

Wide Variety of Components

IN a paper given at the April meeting of the American Electrochemical Society, J. J. Cordiano, of the Hardy Metallurgical Co., New York, stated that copper plays an important rôle in the production of 75 per cent. of all the metal powder parts manufactured to-day. He pointed out that a large percentage of this class of work is produced by cold pressing in steel dies followed by sintering the moulded components in a protective atmosphere. Parts exhibiting a wide variety of mechanical and physical characteristics may be obtained by manipulation of the various aspects of moulding technique, such as the type of metal powder (*e.g.*, single or mixed metals, or mixed metals and non-metals); the moulding pressure; the time, temperature and atmosphere of sintering; and the post-sintering treatment. For example, a metallic component having an apparent specific gravity of 5.5, a liquid absorption capacity of 20 to 25 per cent., and a tensile strength of 10,000 lb./sq. in. may be produced from a copper powder. On the other hand the same copper powder can be processed to form components indistinguishable from similar ones made from solid wrought copper.

Four Techniques

Components produced from copper powder may be divided into four groups, each demanding its own fabrication technique, as follows: (1) The production of porous parts, *e.g.* porous bearings; (2) the production of high-strength, high-density parts, *e.g.*, tungsten-copper electrode tips; (3) the production of bi-layer and strip material, *e.g.*, steel-backed copper-base bearings; and (4) the production of highly porous parts, *e.g.*, filters.

Porous Parts: Components requiring a porosity of 5 to 30 per cent. can be produced with completely automatic equipment. The metal powder is lubricated by mixing with it a volatile powder, such as salicylic or stearic acid. The mixture is fed, *via* automatic hoppers, to the moulds where it is compressed at from 20 to 40 tons/sq. in. The moulded components are then heat-treated in a continuous type furnace provided with a protective atmosphere and, finally, they may be re-pressed, if desired.

High-Density Parts: In the production of high-density, high-strength components, the powder mixture is compressed at from 40 to 100 tons/sq. in., followed by sintering for a period of time longer than for porous parts. Often they are re-pressed and re-sintered, or annealed, to improve their properties. An alternative but less satisfactory method involves pressing and sintering in one operation.

Bi-layer Strip Parts: The method used for these parts is similar to those previously outlined except for the equipment used for applying the pressure. The metal powder mixture is spread evenly over a clean strip of metal which has usually been plated with a flash of tin, copper, or nickel. The strip is heat-treated along with the powder in a continuous furnace to bond the metal powder particles to each other and to the strip. Finally, the bi-metallic strip is passed through rolls and then re-sintered.

Highly Porous Parts are made from spherical copper powder. In some cases small amounts of tin are added to the powder, and in others a little of a volatile powdered material. The mixture is fed into heat-resistant moulds and sintered in a protective atmosphere at a temperature up to 900°C., without any compression having been applied. By this method porosities of 50 to 60 per cent. are obtained.

Porous Bronze Bearings

The lecturer illustrated the varied applications of parts made from powdered copper and mixtures of copper and other metallic and non-metallic powders. He pointed out that porous bronze bearings are made from copper-tin and copper-tin-graphite mixtures and have an oil-absorption capacity of 25 to 30 per cent. Starter bushes on motors are now being made from copper-carbon mixtures, giving increased conductivity and life. Diamond grinding wheels have been made with a copper-base metal-powder backing in place of plastic, giving greater strength and life. Steel-backed, copper-base bearings have been developed and used extensively especially in the automobile and aircraft industries. A full report of the lecture is contained in *Iron Age*, April 27, 1944

DALTON MEMORIAL

The Manchester Philosophical Society is honouring the centenary of John Dalton with a memorial lecture, and it hopes to publish a memorial volume in which the whereabouts of Dalton relics will be given (many of the Society's own relics were destroyed by enemy action in 1941). The secretaries would welcome any information relating to Dalton's scientific interests or his connection with the Society; and they are in a position to receive gifts or offers of gifts. The address is 12 Brooklands Avenue, Manchester, 20.

Australian Aluminium

Bauxite and Alunite Deposits

IN a recent address to the Royal Society of Australia, at Canberra, Dr. H. G. Raggatt, Commonwealth Geologist, listed some of the deposits of aluminium ores that are known in Australia, which would provide ample material for the aluminium ingot industry to establish which the Minister of Supply had proposed the allocation of £3,000,000.

The Victorian Mines Department, Dr. Raggatt said, had tested two deposits near Mirboo North, in South Gippsland, 80 miles from Melbourne, and only 20 miles from the State electricity undertaking at Yallourn. The New South Wales deposits at Bundanoon, which had been known for some time, were of lower grade, but had the advantage of being in the near neighbourhood of coal mines, fabricating plants, and shipping facilities. The Tasmanian deposits, discovered in the Ouse valley in 1941, also had the merit of lying near to coal, water, and hydro-electric power.

In Western Australia a pilot plant was being erected to find out whether the alunnite mud deposit at Lake Campion could be used to produce a grade of alumina suitable for the manufacture of the metal. It is working on the residue from the plant which has already been set up for the recovery of a product containing 75 per cent. sulphate of potash and 25 per cent. sulphate of soda at the rate of 5000 tons yearly. This residue comprises about 4½ per cent. of alumina and 37 per cent. of silica. The new pilot plant will make use of hydrochloric acid generated in the potash plant.

PROPERTIES OF METALS

Circular C447 of the U.S. National Bureau of Standards, released a short time ago, summarises the results of a comprehensive survey of the technical literature on the strength and related properties, thermal expansion, and thermal and electrical conductivity of ferrous and non-ferrous metals and alloys at normal, high, and low temperatures. In general, the data are presented in tabular form, although graphical representation is often used to indicate the effects of changing composition or conditions on the properties. Data on aluminium, copper, iron and steel, lead, magnesium, nickel, tin, zinc, a number of miscellaneous metals, and their alloys are included. The circular is not limited to conventional engineering materials but contains data on the properties of many materials which are not usually classed as such. Copies are obtainable from the Superintendent of Documents, Government Printing Office, Washington, D.C. The price is $1.50.

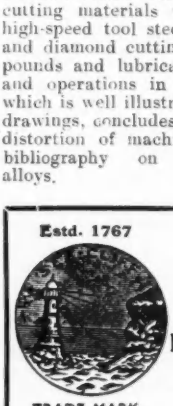
Machining Light Alloys

New Handbook

INFORMATION Bulletin No. 7 of the Wrought Light Alloys Development Association, recently published, price 1s., contains the most recent information on a subject which has hitherto been inadequately discussed in print. The advice of machining experts and of the manufacturers of special machine tools has been obtained, so that the practical aspects of machining have not been sacrificed. It is emphasised that while a number of operations can be carried out with tools used on other metals, the best results are only to be obtained by using the tool angles and shapes appropriate to the light alloys. The various essential modifications for tools are described in detail.

Exceptionally high speeds can be used on aluminium alloys; in certain instances, as in turning and milling, the speed of operation is limited only by the speed of the machine itself. An account is given of the cutting materials used—plain carbon and high-speed tool steels, carbide tipped tools, and diamond cutting tools; of cutting compounds and lubricants; and of tool shapes and operations in detail. The Bulletin, which is well illustrated by photographs and drawings, concludes with a discussion of the distortion of machined components, and a bibliography on machining aluminium alloys.

Estd. 1767



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Parliamentary Topics

Steel Exports

IN the House of Commons last week Sir John Wardlaw-Milne asked the President of the Board of Trade whether in view of the change in the steel position, which would enable this country to export 10,000 tons per month to the U.S.A., he would now remove the restrictions limiting the export of fish-hooks. Mr. Dalton replied in the negative. The exports to the United States referred to consisted of shipbuilding plates, and the arrangement was a special and temporary one. "There is still a shortage of steel in this country, and we are importing large quantities from the United States," added Mr. Dalton.

Swedish Iron Ore for Germany

Sir Archibald Southby asked the Parliamentary Secretary to the Ministry of Economic Warfare what proportion of the Swedish exports of iron ore to Germany came from the Grängesberg mine, and if he had any information as to who were the owners of the mine. Mr. Dingle Foot replied that the mines in question were owned by Trafic A/B Grängesberg-Oxelösund, and constituted only a small part of the iron ore properties in the south of Sweden. The company had, however, a controlling interest in another company, namely Luossavaara-Kiirunvaara A/B, which owns the greater part of the mines in Lapland and northern Sweden. His information was that in 1943 all these mines taken together produced between 55 and 66 per cent. of the total quantity of iron ore exported from Sweden.

"Raw Materials Guide"

Mr. Kendall asked the Minister of Supply whether his attention had been drawn to the fact that in the index of commodities published by his Department certain manufacturers had been prejudiced by the fact that a commodity produced by several firms was described by the name applied to it by one particular foreign manufacturer; why the only kind of synthetic strong yarn mentioned in the index was Nylon; and could he state the names of other forms of strong yarn known to his Ministry.

Sir Andrew Duncan replied that the "Raw Materials Guide" was compiled to indicate the form of control and other particulars in regard to various commodities. Nylon was specifically mentioned, as it was subject to special control arrangements. Other strong yarns used commercially included Durafil, Fortisan, Tenasco and Tyrenka.

Mr. Kendall: Is the Minister aware that Fortisan, manufactured in this country, is very much stronger than Nylon? Will he take the necessary steps to encourage the manufacture of this important British product?—Sir A. Duncan: The purpose of this Guide has nothing to do with the respective qualities of these products.

Secrecy over Penicillin

Mr. Salt asked whether the Minister of Supply, in view of the desirability of removing all obstacles to the rapid development of the large-scale manufacture of penicillin, would permit full publicity with regard to the methods of manufacture and withdraw those objections hitherto raised on security grounds. Mr. Peat replied that he was not aware that large-scale production of penicillin was being impeded through lack of information. The general method of manufacture had been published in the technical press.

A CHEMIST'S BOOKSHELF

INSECT PESTS OF FOOD. By Dr. H. E. Hinton and Dr. A. S. Corbet. London: H.M. Stationery Office. Pp. 148. 5s.

Moths and their larvæ are a serious cause of trouble and loss to the food trades, and this handy and authoritative guide to the identification of moths and moth larvæ should be invaluable to everyone concerned with getting rid of these pests. Manufacturers of insecticidal materials and their technical staffs will find it a useful addition to their bookshelves. The two authors, now serving as pest officers with the Ministry of Food, wrote the papers which constitute this volume primarily for the use of the Ministry's inspectors. This reviewer hopes that the modicum of entomological knowledge needed before one can use the comprehensive and somewhat complicated identification keys can be as easily acquired as the authors assume. It might have been a good idea to have included a glossary of the technical terms which will be new to most non-entomologists.

DETERMINATION OF PARTICLE SIZE IN SUB-SIEVE-RANGE. London: British Colliery Owners' Research Association and British Coal Utilisation Research Association. Pp. 70. 7s. 6d.

Many industrial processes involve the use of powdered materials which depend critically upon proper control of particle size. Some of the problems inherent are extremely difficult: for example, the particle size of carbon black was not known with certainty until the electron microscope became available. Accordingly, a conference was convened which met on June 30, 1941, and again on July 10, 1942, to consider the problem of size analysis. At the first meeting a paper was presented on methods by two workers from each of the organisations concerned and the subject was further discussed at the second meeting. The initial paper

and the verbatim account of the discussions form the subject matter of this small booklet. The methods reviewed were: (1) the direct-view microscopic method; (2) the light-extinction sedimentometer method; and (3) the Andreason sedimentation method. A routine test was worked out in the initial paper based on the light-extinction sedimentometer.

There are two main lines of interest in size determination; one of these is where the chief concern is in the relation of size to total surface. This was not discussed to any extent at these conferences. The other line, for the discussion of which this conference was specially summoned, is the determination of the size distribution below the sieving range but above that wherein the difficulties of Brownian movement and the closeness of the particle size to the wave-length of light interfere, *i.e.*, from 80 to about 1. Very diverse points of view were expressed. No definite conclusions seem to have emerged as to the best method to be adopted, but the suggestion was made that a team of co-operating laboratories should exchange samples and experiences with the object of arriving at an accurate and agreed method. This report will be of high value to the specialist in this field, but it is essentially a report for the specialist.

THE OXY-ACETYLENE HANDBOOK. New York: Linde Air Products Company. Pp. 587. $1.50.

This authoritative work on basic oxy-acetylene welding and cutting procedures should be invaluable both as a guide for self-instruction and as a standard classroom text-book in trade and technical schools and engineering colleges. It covers the entire range of the oxy-acetylene process, giving clear instructions for handling all the common commercial metals, together with simple explanations of the fundamental principles of the various methods of depositing and controlling molten metal. Considerable space is devoted to an explanation of the operating principles of oxy-acetylene equipment and instructions for its care and maintenance. More than 400 illustrations, many tables, a comprehensive index, and appendix with ample data contribute to the handiness of the volume for shop reference purposes.

General News——From Week to Week

The price of gas coke is increased by four shillings a ton and of hard coke by six shillings a ton from August 1, announces the Ministry of Fuel and Power.

The British Association committee's report on post-war university education, following two interim reports, has now been published. The price is 2s. 6d.

A sound film, on 35 mm. stock, showing how difficulties in finding substitutes for various war materials were overcome by American industry, can be borrowed without charge from the American and British Commonwealth Association, 18 South Street, London, W.1.

The Ministry of Aircraft Production, Directorate of Instrument and Aircraft Equipment Production (Inst.P.4), Millbank, London, S.W.1, has taken over the responsibilities previously held by the Board of Trade as the production authority for photographic silver-sensitised papers. An inter-departmental committee will be set up.

The first commercial work on dehydration of fish has been started at the Aberdeen works of Marshall and Co., Aberdeen, using plant installed by the Ministry of Food, to experimental designs tested and created at the Torry Research Station, Aberdeen. The process is at present confined to herrings, which are in surplus at the present time.

The employees of an I.C.I. explosives factory in Scotland have sent a donation of £2 to the Merchant Navy Comforts Service. Since the beginning of the war this organisation has distributed over 3,000,000 gifts.

The fuel efficiency campaign carried on by the Ministry of Fuel and Power has led, in its first 18 months, to an estimated saving of nearly 4,000,000 tons of coal in 11,000 factories with a total annual consumption of 39,000,000 tons. This estimate does not include further economies in gas, electricity, and fuel oil.

A workshop microscope, with a magnification of × 40 and a field view of about 0.2 in. diameter, is marketed by Machine Shop Equipment, Ltd., of 136-142 Victoria Street, London, S.W.1. Designed for examining surfaces, it has a measuring scale graduated in 100 divisions of 0.001 in. so that differences as small as 0.00025 in. can easily be estimated.

The provision of a technical college for Scunthorpe, the industry of which is dominated by iron and steel making, is recommended by the Lindsey County Council Education Committee. It is estimated that out of the thousand pupils who would attend 90 would be studying chemistry and metallurgy, while 300 would take engineering subjects.

A new exhibition with the theme "Your Paper Goes To War" has been designed by the Waste Paper Recovery Association and, mounted on a specially-constructed mobile trailer, it will tour the principal industrial areas.

Public control of the chemical industry has become a vital social question, said Mr. Robert Edwards, N.W. area organiser of the Chemical Workers' Union, speaking at the summer school of the Labour Colleges at Bangor recently. "People know very little about the chemical industry," he said, "partly due to the fact that it is largely a new industry and partly because the powerful monopolists who control industry consistently withhold information."

A memorandum on thioplasts, No. M.11, has been published jointly by the Ministry of Supply, the Admiralty and the Ministry of Aircraft Production. The publication is based on research carried out by the Dyestuffs Division of I.C.I., Ltd., on behalf of these three Government departments, and gives details of the compounding and processing of six synthetic rubbers, *viz.*, Novoplas A, and Thiokols A, AZ, F, FA and N (GR-P).

The proposal of British Titan Products Co., Ltd., to erect a plant at Piewipe, near Grimsby, is being opposed by the N.E. Sea Fisheries Committee on the ground that effluents would pollute the Humber. The Humber Conservancy Board, on the other hand, has withdrawn its opposition after receiving an assurance that the rate of effluent discharge will not exceed 45,000 gallons an hour, that the sulphuric acid content will be kept to a minimum, and that the pipe-line will be carried below low-water mark.

A committee has been appointed by the Treasury and the Ministry of Fuel and Power to consider the effect of the hydrocarbon oil duties on the supply of raw materials and the development of the chemical industry; and the extent to which a change in those duties would affect industries engaged in the production of similar products from coal. The committee consists of Sir Amos Ayre (chairman), Sir John Fox, Sir Robert Robinson, and Mr. A. S. MacHarg.

Addition of an olefine sulphide, specially processed, to Thiokol has made possible a sulphur-Thiokol mortar which is claimed to compare favourably with concrete so far as strength is concerned. Inert at temperatures up to 200° F., unaffected by hot or cold acid, corrosive salt or mild alkaline solutions, and with a bond to brick of 400-500 lb./sq. in., it is being used to save steel and natural rubber in the construction of tanks for pickling steel, chemical vats, and industrial sewers for disposing of acid and other wastes.

The Board of Trade announces that applications for licences previously sent to the Export Licensing Department, Bank Buildings, Princes Street, London, E.C., should in future be sent to Stafford House, King William Street, London, E.C.4. It will be of considerable assistance to the Department if for the present applicants will restrict their applications to urgent cases. Arrangements have been made with the Customs under which any licences produced to them with a period of validity expiring in July and August, 1944, will be regarded as automatically extended until August 31, 1944.

Coefficients of friction for minerals, rarely quoted in reference works on mineralogy, have a bearing on transport in bulk, and are useful when it comes to setting of screens and chutes. Comparison of frictional tendencies can be made, for instance, when minerals are passing through reduction plants, says a recent number of *Mine and Quarry Engineering*, which gives the following figures for the slope (in degrees from the horizontal) at which some of the commoner minerals and rocks will start sliding: limestone, 31½; coal, 30; magnetite, 28; calcite, 27; quartz, zincblende and haematite, 25; and galena, 24.

National Arbitration Tribunal Award No. 597 gives details of a wage claim made by members of the Chemical Workers' Union employed at the Widnes works of Thomas Bolton and Sons, Ltd., the copper-manufacturing firm. According to this publication the firm had agreements with the Amalgamated Engineers Union and the National Union of General and Municipal Workers, but "felt unable to negotiate with the Chemical Workers' Union." An all-round increase of 1d. an hour had been granted following a similar increase awarded by the Heavy Chemicals J.I.C. The tribunal found against the claim.

Foreign News

Sodium antimony lactophenate is being marketed in the United States as an insecticide.

Plans are in hand in Finland to build twenty new tar plants which would bring the number of the country's tar plants up to thirty.

Recent exploratory work conducted at the Malagash salt mine in Nova Scotia has revealed several hundred thousand tons of salt containing an average of eight per cent. potassium chloride.

Aluminium production is expected to start shortly at Wangaratta, Victoria, Australia, based on bauxite from the Gippsland district. The output will go into aircraft manufacture.

The new coins coming into currency in Spain are made of an alloy of 90 per cent. copper and 10 per cent. aluminium.

Production of mercury from cinnabar in the Union of South Africa last year amounted to approximately 88,000 lb., sufficient to fill the country's needs.

American manufacturers of carbon black, now in extremely short supply, have been asked to consider the construction of carbon black plants in Russia and Iran.

For synthetic liquid-fuel investigations the U.S. Bureau of Mines has been allocated the sum of $30,000,000. Small-scale research at Pittsburgh is to be expanded, and larger experimental plants will be built at Bruceton.

A new synthetic lacquer derived from soya beans has been developed at the Northern Regional Research Laboratory of the U.S. Department of Agriculture, Peoria, Illinois. Known as Nortlac, it is an ethylene diamide polyamide.

Manufacture of lignin plastics from waste liquors at pulp plants is to be undertaken by the Howard Smith Paper Mills, Toronto, Canada, as the result of substantial expenditure on research. A pilot plant sufficiently large to permit manufacture on a commercial scale is being built.

A plant to cost £2,500,000 and to produce 150 tons daily of ammonium sulphate is planned for the State of Travancore in southern India. Negotiations are going on to secure the necessary machinery for installation by an American firm.

A centre for industrial research in the field of high-frequency electrical heating has been established in the Department of Chemical Engineering, Columbia University, under the direction of Professor Hixson and Dr. P. W. Schutz.

Copper and tungsten are now being mined on an economic basis in Namaqualand, S.W. Africa, and the South African Government is reported to be contemplating further development. In the Potgietersrust district investigations are in hand with the hope of finding molybdenum in paying quantities.

The Argentine State Oil Company, the Y.P.F., announces that oil has been discovered near Caleta Oliva, south-east of the Comodoro Rivadavia oil fields. Oil geologists point out that this discovery is of importance as it confirms the expectations held with regard to the oil-bearing zone round the Gulf of San Jorge.

Authorisation has been given by the Spanish Government for the construction of a new synthetic resin factory at Mataró, near Barcelona; and for an electrochemical plant for the production of caustic soda, chlorine, hydrogen, etc., at Cardona, north of Barcelona. Cardona is famous for its "salinas"—large natural rock-salt deposits.

U.S. mercury production in 1943 totalled 51,929 flasks, 90 per cent. of which came from 28 mines; 33,812 flasks were produced in California, the next highest States being Idaho, Nevada and Oregon, each turning out over 4000 flasks. The Hermes mine in Idaho, second largest producer in 1943, has since ceased production.

A fully-mechanised nitrate plant is being built by the Tarapaca and Antofagasta Nitrate Co. of Santiago, Chile, at a cost of about $12,000,000. The plant is expected to have an annual capacity of 200,000 tons which may be increased to over 300,000 tons. Nitrate reserves within a radius of 10 miles of the factory amount to 70 million tons.

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for errors that may occur.

Mortgages and Charges

(Note.—The Companies Consolidation Act of 1908 provides that every Mortgage or Charge, as described therein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every company shall, in making its Annual Summary, specify the total amount of debt due from the company in respect of all Mortgages or Charges. The following Mortgages and Charges have been so registered. In each case the total debt, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced.)

FLEETWOOD CHEMICAL CO., LTD., London, S.E. (M., 5/8/44.) July 12. £300 debentures, part of a series already registered. *£1515. December 31, 1941.

HALLIDAY & CO., LTD., South Reddish, bleachers and dyers. (M., 5/8/44.) July 7, £6809 13s. 9d. debenture stock secured by Trust Deed dated June 29, 1944; general charge (subject, etc.). *£3750. April 27, 1940.

BRITISH ALUMINIUM CO., LTD., London, E.C. (M., 5/8/44.) July 17, disposition by Paul Colbeck with consent of co. granted in implement of a Trust Deed dated September 12, 1934; charged on 17 Manse Crescent, St. Ninians, with ground attached. *£3,270,644. April 14, 1944.

LAFARGE ALUMINOUS CEMENT CO., LTD., Ripley. (M., 5/8/44.) July 6, mortgage to Builders and General Building Society securing £10,000 and any other moneys, etc.; charged on 72 Brook Street, Mayfair, London, W., and benefit of a licence, etc. (ranking in priority to a debenture dated January 1, 1941). *£1995. January 12, 1944.

Company Winding-up Voluntarily

HEMERDON WOLFRAM, LTD. (C.W.U.V., 5/8/44.) By special resolution, passed July 17. S. R. Hogg, River Plate House, Finsbury Circus, London, E.C.2, appointed liquidator.

Company News

The British Thermostat Co., Ltd., is again paying a final dividend of 11 per cent., making 18½ per cent. (same).

Sangers, Ltd., have increased their ordinary dividend for the year ended April 30, from 22½ per cent. to 25 per cent. by the payment of a final dividend of 20 per cent. (17½ per cent.).

International Diatomite, Ltd., announce a net profit of £183 (£2294) for the year ended March 31. Dividend on ordinary shares, nil (3 per cent.). The directors report a difficult year owing to abnormal trading conditions, and the impossibility of obtaining raw material from Denmark.

The reduction from £750,000 to £266,480 in the capital of the **Methylating Co., Ltd.,** by returning capital not required and cancelling unissued shares has been confirmed by Mr. Justice Cohen. Counsel for the company stated that it was carrying on a flourishing and successful business and had capital in excess of its wants.

Chemical and Allied Stocks and Shares

ALTHOUGH less active, stock markets remained firm with main attention again centred on industrial shares on hopeful views of post-war prospects. Gilt-edged stocks again tended to move higher, while in other directions Gas Light & Coke ordinary were a good feature, rising to 23s. xd. on the hope that the half-yearly payment foreshadows a return to 5 per cent. dividends. Imperial Chemical at 40s. 3d. were little changed on balance, while Borax Consolidated deferred remained firm at 40s., and Dunlop Rubber were close on 48s. A strong feature was provided by British Oxygen with an advance to 90s. Barry & Staines were 54s., and Nairn & Greenwich 80s.

Under the influence of the full results and the progress and good prospects of the plastics side of the business, De La Rue ordinary moved up to £9½, at which the yield is slightly over 4½ per cent. on the basis of the past year's 40 per cent. dividend. The latter is a conservative payment, as earnings on the shares were nearly 73 per cent.; £50,000 is again added to reserve, and the carry forward increased from £68,158 to £75,387. Among shares of other companies connected with plastics, British Industrial 2s. ordinary were 7s. 9d., and Erinoid 5s. shares 11s. 3d.

Boots Drug at 59s. 9d. held most of an earlier advance, aided by further consideration of the financial results; the increased 30 per cent. dividend came out of earnings of nearly 61 per cent. on the 5s. ordinary units, apart from the fact that the subsidiaries have, of course, retained a proportion of their profits. United Molasses 6s. 8d. units have remained favoured awaiting the full results, changing hands around 39s. 6d. British Aluminium were better at 51s. 9d., and Triplex Glass firmer at 45s. General Refractories 10s. ordinary were again around 18s. 6d., being favoured on hopes of increased earnings and dividends after the war, while British Match were 44s., although elsewhere Lever & Unilever eased slightly to 42s.

Still under the influence of the higher dividend, Richard Thomas 6s. 8d. units kept firm at 12s. 7½d. xd., it being expected that the full results will show that a good proportion of profits is being placed to reserves, etc. Consett Iron 6s. 8d. units were 8s. 9d., yielding over 5½ per cent. on last year's 7½ per cent. dividend; a further 7 per cent. could have been paid in dividend if profits had been fully distributed. Reflecting the good impression created by the past year's results and strong balance-sheet, Metal Box ordinary were firm at 94s. 6d. Stewarts & Lloyds were 58s. 6d., Tube Investments 100s. 6d., Babcock & Wilcox 54s., Guest Keen 42s., Neepsend 34s. 3d., United Steel 27s. 1½d., and Allied Ironfounders 50s. 9d.

British Plaster Board 5s. ordinary remained an active feature, rallying strongly to 41s. 6d. following an earlier reaction. Associated Cement were firm at 69s. 6d., Monsanto Chemicals 5½ per cent. preference again 23s., and B. Laporte firm at 85s., while W. J. Bush were 66s. 3d., and Greeff-Chemicals 5s. ordinary 8s. 9d. Fisons at 54s. and Valor at 55s., remained steady. Timothy Whites showed firmness at 38s., and Sangers were 29s. 6d. Textiles were less active, Bradford Dyers being 25s., Calico Printers 17s. 3d., and Bleachers 11s. 3d., with Courtaulds 59s., and British Celanese 30s. 9d. Elsewhere, Amalgamated Metal were 18s. 7½d., and Imperial Smelting 14s. 7½d. Leading oil shares did not all hold best prices, "Shell" being 88s. 9d., although Anglo-Iranian were 123s. 9d. Attocks rose to 64s. 9d., but Ultramars moved back to 73s. 9d.

British Chemical Prices

Market Reports

RATHER quieter conditions are reported on the London general chemicals market this week and fresh business is on a smaller scale than of late chiefly because of the holiday period, which is also affecting delivery against contracts. There has been little alteration in the supply position and in most cases dealers already have sufficient

orders on their books to absorb supplies as they become available. The demand for solid and liquid caustic soda, chiefly against commitments, has been on a good scale and steady pressure for supplies of soda ash and bicarbonate of soda has also been reported. There has been a fair aggregate movement of supplies of industrial refined nitrate of soda and a steady demand has been reported for both the commercial and photographic descriptions of hyposulphite of soda. Offers of chlorate of soda are meeting with a ready outlet. Among the potash materials moderate supplies of solid caustic potash are being distributed steadily to essential users on the basis of the fixed prices, while liquid caustic potash continues in limited supply. A steady inquiry is being dealt with for acid phosphate of potash and a good demand is reported for permanganate of potash. Quiet trading conditions are reported in the coal-tar products market and there is little change on the week.

MANCHESTER.—The undertone has remained firm in virtually all sections of the Manchester chemical market during the past week, although actual changes have been few and of little consequence. Movement of supplies of textile chemicals to users in the Lancashire and West Riding areas has been affected to some extent by holiday conditions at a good many centres, as has also the demand in several other directions, but, allowing for this factor, the position of the market from the point of view both of new business and of deliveries under contracts is reasonably satisfactory. The demand for the tar products, especially for the light distillates, has been on steady lines.

GLASGOW.—As the Glasgow Fair holidays have now been completed, business in the home trade has resumed its usual day-to-day transactions. Export inquiries are again steady, and prices remain firm, with no actual changes to report.

The fact that goods made of raw materials in short supply owing to war conditions are advertised in this paper should not be taken as an indication that they are necessarily available for export.

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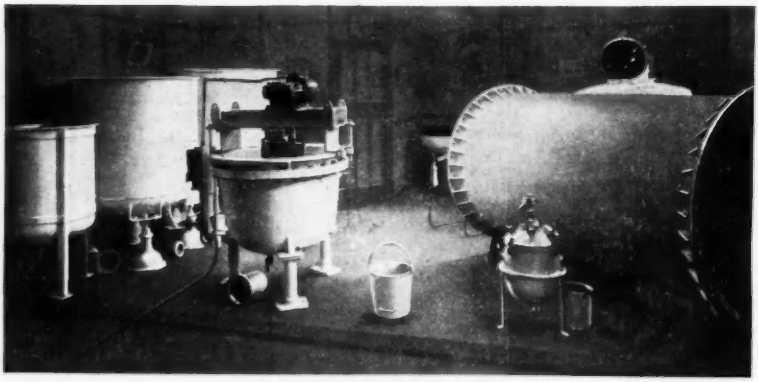

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VERTICAL mild steel Vacuum **STILL,** 7 ft. 0 in. high by 4 ft. 2 in. dia., arranged with blown steam heating coil in bottom; 16 in. by 12 in. manhole and sundry connections; unit complete with barometric condenser 4 ft. 4 in. deep by 2 ft. 4 in. dia., and mild steel separator 3 ft. 0 in. deep by 2 ft. 4 in. dia.; swan-neck.

Copper steam jacketed **STILL** by John Dore, 5 ft. 3 in. deep by 3 ft 3 in. dia.; 10 in. dia. opening to body of still; bolted on steam jacketed dished bottom section; two bow type agitators mounted on vertical shaft driven through bevel gears from f. and l. pulleys.

Copper steam jacketed **STILL** by John Dore, 3 ft. 4 in. deep on straight by 3 ft. 6 in. dia.; bolted on domed cover with inspection windows; steam jacketed bolted-on bottom, giving overall internal depth of 5 ft. 9 in.; 12 in. dia. inspection door; copper swan-neck and coil condenser.

Vertical all copper direct fired **STILL,** oil jacketed; 2 ft. 9 in. deep internally by 2 ft. 0 in. dia.; bolted-on domed cover with 6 in. vapour connection, swan-neck and condensing coil. Still mounted in mild steel skirt for firing.

Vertical copper lined steam jacketed **STILL**; 2 ft. 4 in. deep by 1 ft. 6 in. dia.; dished bottom with bolted-on cast iron jacket; domed cover arranged copper swan-neck, leading to coil condenser.

Vertical **EVAPORATION PLANT** having cast iron; calandria portion 3 ft. 4 in. deep by 3 ft. 9 in. dia. containing 226—1¼ in. dia. tubes, 10 in. dia. return tube; vapour portion of riveted copper 6 ft. 6 in. deep on straight by 3 ft. 9 in. dia.; domed top with 3 ft. 0 in. deep by 2 ft. 6 in. dia. vapour trap; complete with sight glasses, manhole and usual fittings and marine type condenser 7 ft. 0 in. long by 2 ft. 0 in. dia., 254—¾ in. tubes.

All copper **FRACTIONATING COLUMN**; overall height 13 ft. 6 in. by 10 in. dia., comprising four sections each 3 ft. 0 in.; each section contains five trays fitted with bubbling hoods; copper coil dephlegmator 12 in. high at top.

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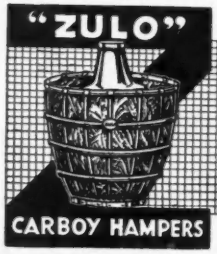

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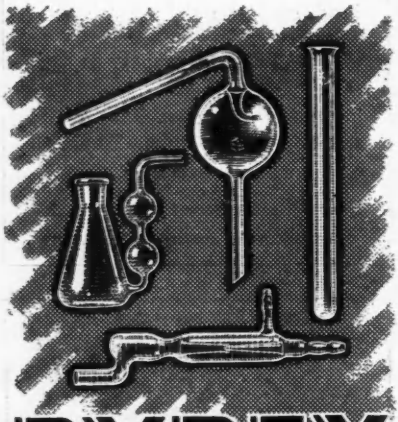

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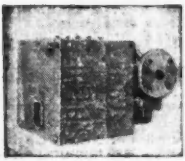

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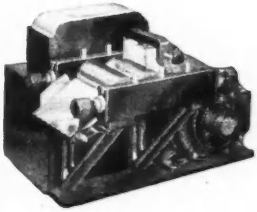

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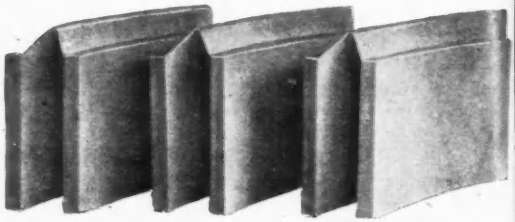

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